



FINAL REPORT:

Yarriambiack Creek Waterway Action Plan

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Abbreviations

Alluvium	Alluvium Consulting Australia Pty Ltd
CMA	Catchment Management Authority
Cth	Commonwealth of Australia
DELWP	Department of Environment Land Water and Planning
DEDJTR	Department of Economic Development, Jobs, Transport and Resources
EVC	Ecological Vegetation Class
ISC	Index of Stream Condition
NRM	Natural Resource Management
MERI	Monitoring, evaluation, reporting and improvement
Vic	State of Victoria
WAP	Waterway Action Plan
WCMA	Wimmera Catchment Management Authority
WRCS	Wimmera Regional Catchment Strategy 2013 – 2019
WWS	Wimmera Waterway Strategy 2014 – 2022
YCAC	Yarriambiack Creek Advisory Committee
YSC	Yarriambiack Shire Council
YCCCC	Yarriambiack Creek Community Consultative Committee

Glossary

Anabranh	A secondary channel of a waterway that splits from the main channel and later re-joins it.
Confined	Channel planform is controlled by valley margins, with little or no floodplain.
Ephemeral	A waterway, waterbody, wetland or swamp that only exists for a short period following heavy precipitation and remains dry for long periods.
Distributary system	A waterway channel that conveys water away from the main channel and distributes it to another channel or area.
Effluence	The location where a distributary channel flows away from a main river channel (the reverse of a confluence)
Headcut	Sharp step or small waterfall at the leading edge of a gully as a result of active incision.
Incision	Process of channel deepening and widening.
Riparian zone	Any land that adjoins, directly influences or is influenced by a body of water.
Scour	A form of bank erosion caused by sediment being removed from stream banks particle by particle. Scour occurs when the force applied to a bank by flowing water exceeds the resistance of the bank surface to withstand those forces.
Unconfined	Channel planform is not restricted by valley margins, the channel is free to meander across the floodplain which often results in multiple past and current courses.

1 Background

1.1 Introduction

The Wimmera Catchment Management Authority (WCMA) engaged Alluvium Consulting Pty Ltd (Alluvium) to assist the WCMA with an audit of the waterway condition across the Yarriambiack Creek catchment, and the development of a Waterway Action Plan (WAP).

Yarriambiack Creek is situated in the Wimmera Basin (Figure 1). The upper reach from the Wimmera River to Warracknabeal is recognised as a priority waterway in the Wimmera Waterway Strategy 2014 – 2022 (WWS) (WCMA 2014). The catchment covers approximately 1360 km², from the Wimmera River effluence near Longerenong to Lake Coorong. Yarriambiack Creek is approximately 120 km long, the majority of which is ephemeral. Warracknabeal is the main township within the catchment.

Yarriambiack Creek is a distributary of the Wimmera River, meaning it carries water away from the main waterway (the Wimmera River). The creek rarely flows and only receives water during high flows and floods. Despite this, there is passionate community interest in the condition and management of the waterway. Within the Wimmera CMA area, weir pools are located at Jung, Warracknabeal and Brim, and are popular areas for water skiing, camping and other recreational activities.

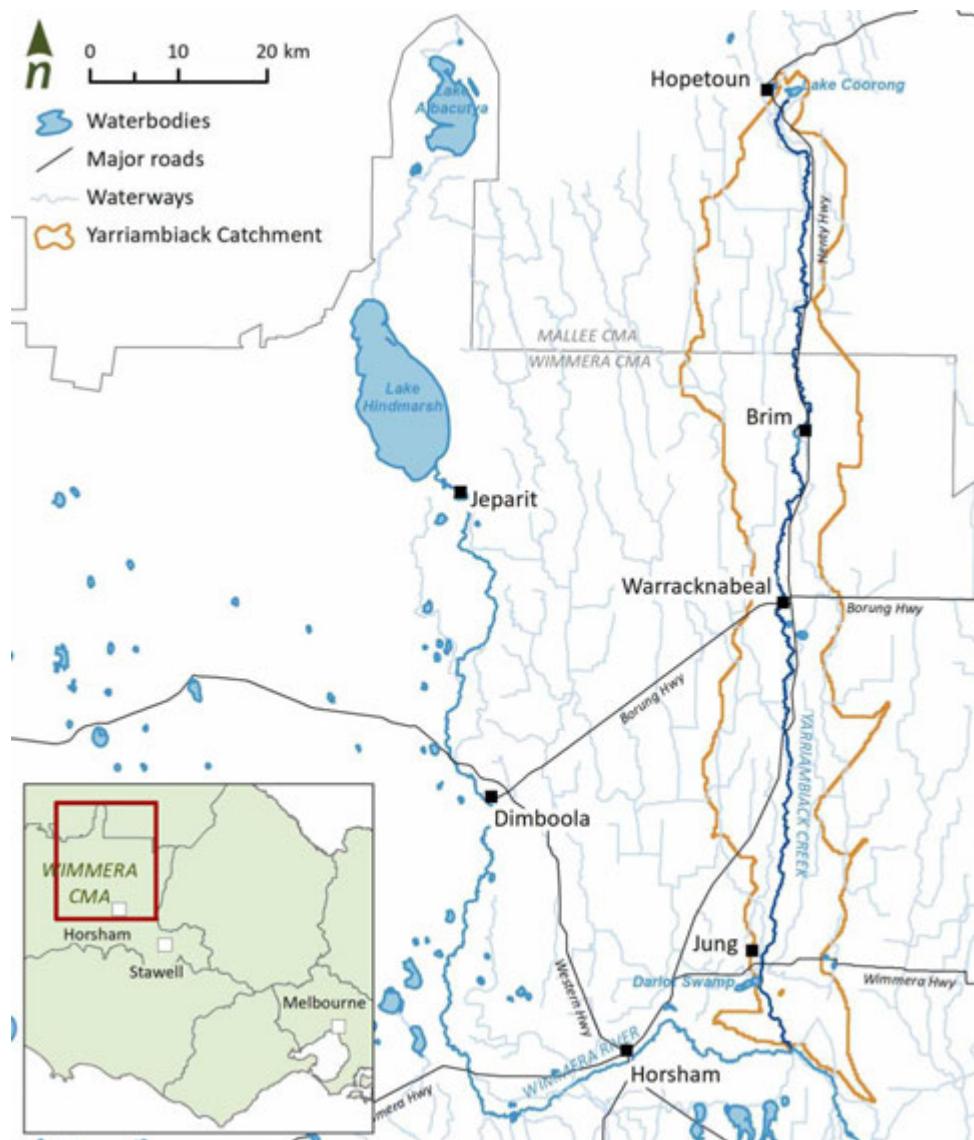


Figure 1. Yarriambiack Creek catchment location

As caretaker of waterway health, the WCMA develop WAPs to guide management actions and direct the implementation of waterway works across all catchments in the Wimmera region. The most recent WAP that included the Yarriambiack Creek was the *Waterway Action Plan for the Regulated Streams of the Wimmera* developed in 2007 by EarthTech. There have also been two Yarriambiack Creek Management Plans in 1998 (Yarriambiack Creek Community Consultative Committee, 1998) and 2004 (Yarriambiack Creek Advisory Committee, 2004). This project WAP is closely linked to the objectives, directions and actions stipulated in the previous WAP, Yarriambiack Creek Management Plans, the WWS, as well as the Wimmera Regional Catchment Strategy 2013 – 2019 (WRCS). The process involved in developing a WAP is important for creating and consolidating partnerships between the CMA, landholders and other stakeholders.

1.2 Project purpose and scope

The purpose of this WAP is to provide a condition assessment of the Yarriambiack Creek waterways, and to develop a prioritised program of management actions to protect and improve river health. Identification of reach-scale issues and the provision of a technical and financial basis for on-ground waterway works to government are important aspects of this WAP.

The scope of the condition assessment for the Yarriambiack Creek WAP is focused on desktop data review and extensive on-ground assessment of variables relating to:

- The riparian zone (vegetation types, condition, connectivity, fencing extent, and weeds)
- The physical form of the waterways (channel form, sediment movement, and stability).

The WAP consultation processes has included on-site discussions with landholders, community meetings, and discussions with stakeholder group representatives including the Yarriambiack Creek Advisory Committee (YCAC), Yarriambiack Shire Council and the WCMA.

1.3 Project approach

The approach adopted for the development and delivery of this WAP was based on the WCMA preference for a field-based catchment scale audit focused on channel form and vegetation condition. The WAP development has included the following stages.

Project definition

The project definition phase involved an inception meeting with the WCMA, and the collation and review of background information including previous assessments, strategies and management plans.

Desktop analysis

Given the length of the Yarriambiack Creek, a desktop analysis of high resolution aerial imagery and available GIS layers was undertaken to highlight priority areas and guide field inspections. Table 1 details these layers and how they were applied to this Waterway Action Plan.

Table 1. GIS datasets utilised during desktop analysis and background data review

Dataset (Owner)	Currency or date collected	Description	Application
Aerial imagery (collected for this project)	16 January 2018	4 band (Red, Green, Blue, Infrared), 7 cm resolution aerial imagery of the Yarriambiack Creek.	Identification of fence lines, erosion and vegetation health in areas inaccessible during field work. Infrared imagery also assisted in identifying potential exotic species to be verified during field investigation.
2010 Index of Stream Condition (DELWP)	2010	A variety of channel form and riparian vegetation layers developed through the 2010 ISC including Bare ground, vegetation width, fragmentation and bank condition.	These series of layers were used to identify potential areas of bank erosion and/or vegetation degradation to guide field investigation.
Native vegetation (DELWP)	01 February 2018	Modelled 2005 and 1750 native vegetation Ecological Vegetation Classes and Bioregional Conservation Statuses.	Identification of particularly significant or vulnerable communities assisted in guiding field inspection and prioritising management actions.

Victorian Land Use (DEDJTR)	2016	Land tenure, land use and land cover across Victoria at cadastral parcel level.	Land use and land cover attributes were used to highlight areas of potentially unfenced private pasture for verification during field investigation.
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Stakeholder engagement

Stakeholder presentations and meetings were conducted throughout the WAP development processes. These included community consultations (March 2018 and June 2018), as well as on-site discussions with individual landholders (March 2018). The engagement process provided the project team with a broader understanding of catchment history, past works, catchment values, challenges, and stakeholder perspectives on priority management actions, as well as guiding field inspections.

Field inspections

The field program included three days of inspections from 21st to 23rd March 2018. The purpose of the field inspections was to document on-ground observations of the majority of accessible waterway length across the Yarriambiack Creek catchment, to meet on-site with landholders, and to verify the condition of areas highlighted through desktop analysis.

Field inspections were undertaken by Jace Monaghan (WCMA), Stuart Cleven (waterway engineering, Alluvium), Emma Hodson (geomorphic processes, Alluvium) and Neil Marriott (vegetation, White Gums Australia). In addition to documenting on-ground observations, the field inspections provided the project team with an understanding of catchment history and waterway condition from a landholder perspective, an appreciation for the waterway health works completed to date across the catchment, and landholder perspectives on priority management actions (fencing and revegetation, weed control etc.).

The majority of waterway length within the catchment was inspected on-ground, and data recorded for 102 reaches of varying length (sites) (Figure 2). A “site” was defined where a change in river condition, health or potential management action was recorded.

Condition variables

In addition to the assessment of desktop data, a set of condition variables were recorded on-ground during the field inspections. Riparian fencing and stock access was also mapped along banks for the waterways inspected. Observations were logged in an electronic spatial database. The spatial database has been provided to the WCMA in shapefile format and contains the following information:

- Physical condition variables (presence of erosion)
- Vegetation condition variables (presence of significant species, weeds, etc.)
- Extent and condition of riparian fencing
- Stock access

These variables are described in more detail below, and a complete list of data collected is provided in Attachment B.

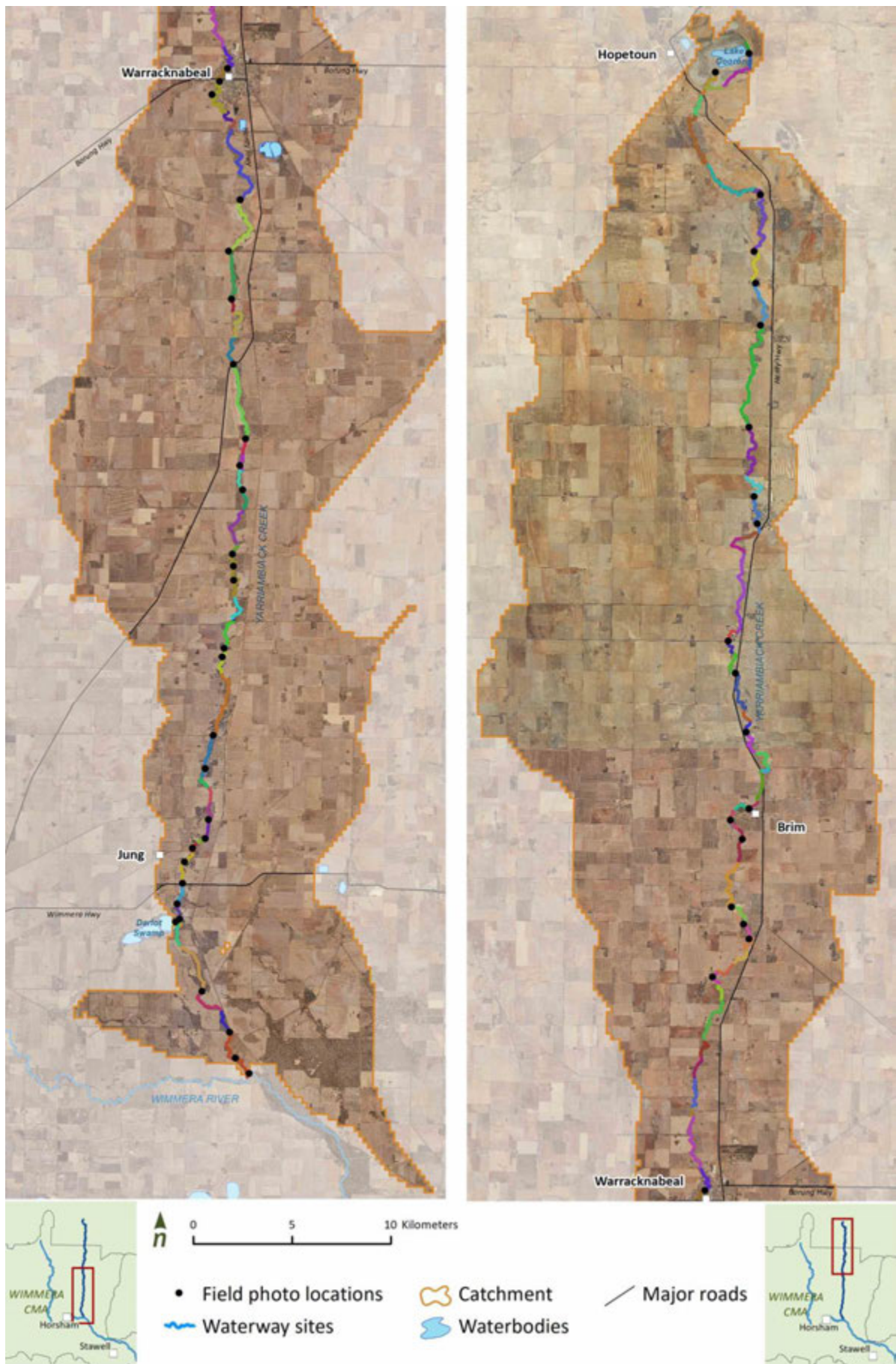


Figure 2. Yarriambiack Creek catchment with coloured sites and photo locations during March 2018 field inspections

Vegetation condition

Vegetation condition variables were collected during the assessments, including:

- Significant vegetation
- Potential or evidence of natural regeneration
- Continuity of riparian corridors
- Noxious weeds (including Horehound, Boxthorn, Heliotrope, Prickly Pear etc.)

A full species list is provided in Attachment A, with a spatial database of vegetation locations and species provided to the WCMA in shapefile format.

Fencing and stock access

The presence / absence of fencing and evidence of stock grazing was recorded along the waterway. Fencing was recorded as either:

- Effective – Fencing is present on both sides, continuous and in good condition
- Ineffective – Fencing is only present on one side, in poor condition or not present at all
- N/A – areas in towns, roads or in cropped land where fencing is not required

Stock was recorded as either:

- Evident in Creek reserve corridor
- Evident in neighbouring land
- Not evident in either the Creek reserve or neighbouring land

Physical condition

Physical condition variables were recorded during the assessments including aspects of:

- Channel stability / erosion
- Presence and location of existing in-stream structures (grade control, other)
- In-stream habitat (e.g. large wood, pools, dams)

WAP development

The WAP development was based on the collation of desktop data and on-ground observations of environmental values, threats to values, and opportunities to improve waterway health within the Yarriambiack Creek catchment. Objectives for management were defined, and prioritised management actions to achieve objectives were developed. Management actions were developed at the site- and reach-scale across the catchment, including indicative cost estimates.

Project outputs

Outputs from this WAP provided to the WCMA, in addition to this report, include:

- An excel spreadsheet of on-ground data observations, cross-referenced to site numbers
- An excel spreadsheet of prioritised management actions
- GIS shapefiles of site locations and digitised data (fencing, waterway attributes, vegetation species)
- Georeferenced photos collected during site visits
- Species list of native and exotic vegetation observed during field inspections

1.4 Relevant investigations and plans

There are several documents and investigations that address past condition of the Wimmera and Yarriambiack catchments and management options for improving river health. These include:

- Geomorphic Categorisation and Stream Condition of the Wimmera River Catchment (Earth Tech 2003)
- Index of Stream Condition (DNRE 1999 and DSE 2004a and DEPI 2010)
- Regional Riparian Action Plan: Wimmera (DEWLP 2015)
- The Sustainable Rivers Audit 2 (ISRAG 2012)
- Wimmera Invasive Plant and Animal Management Strategy (WCMA 2010)
- Wimmera Regional Catchment Strategy 2013 -2019 (WCMA 2013)
- Wimmera River Geomorphic Investigation (Earth Tech 2001)
- Wimmera Water Quality Strategy (WCMA 2002)
- Wimmera Waterway Strategy 2014-2022 (WCMA 2014)
- Yarriambiack Creek Management Plans (1998 and 2004)

The documents listed above have been reviewed for this investigation to provide contextual information for the Yarriambiack Creek catchment and the greater Wimmera region. The information examines the current condition of the waterways, the environmental values and their corresponding threats, as well as the geomorphic form and processes.

The Yarriambiack Creek WAP focuses on providing a concise overview of the current catchment condition based on current desktop data and field inspections in March 2018, in the context of understanding past changes to the catchment. The relevant past investigations and plans listed above provide additional detail on the region. Two of these existing strategies and the Yarriambiack Creek Management Plan (2004) provide particularly important context for the Yarriambiack Creek WAP:

Wimmera Regional Catchment Strategy (2013 – 2019)

This document provides the overarching strategic framework for natural resource management (NRM) within the Wimmera region and aims to ensure a focused, integrated and coordinated direction for all NRM activities. The Regional Catchment Strategy (WRCS) includes twenty-year objectives for native vegetation, rivers and streams, threatened plants and animals (etc.), which have been considered during WAP development, in particular during the objective setting phase of the project. Further, these objectives played a pivotal role in guiding the proposed management actions for this project. Importantly, the WRCS integrates with other strategic documents (i.e. the Wimmera Waterway Strategy 2014 – 2022) to improve the outcomes for the entire catchment.

Wimmera Waterway Strategy (2014 – 2022)

The Wimmera Waterway Strategy (WWS) is the guiding strategic document for the WCMA. The WWS is intended to maintain and where possible improve waterway condition, utilising previous thinking presented in existing strategies and plans. It is considered to be the primary document for community reference in order to understand the long-term approach for the security of the waterway values in the Wimmera region. It directly links to the WRCS as provides the action plan for improving the *rivers and streams* and *wetlands* as natural assets.

The WWS also focuses on connectivity of riparian corridors, improved water quality outcomes and the high social, cultural and economic values of the region.

Yarriambiack Creek Management Plan (1998 and 2004)

These documents provide strategic direction and a vision for the management of Yarriambiack Creek. Both plans are based on extensive consultation with the Yarriambiack community and display the high level of community interest in the future of the Creek. The plans provide extensive background information on the values, condition and priorities for management of the creek across ten management themes including community engagement, linked ecosystems, management of bed, banks and in-stream habitat and monitoring and evaluation. Future directions for the management of the Creek are based on the continuing vision for the Creek:

The Yarriambiack Creek is a community owned natural asset, providing educational, recreational and social opportunities, cooperatively managed to protect and enhance the natural and cultural environment

Yarriambiack Creek Management Plan 1998

This report aims to build on the extensive work undertaken for the Yarriambiack Creek Management Plans through documenting works already undertaken and prioritising future management activities to protect the essential habitat corridor that the Yarriambiack provides in the most cost-efficient manner. The Yarriambiack Creek Management Plans provide context for assessment of previous management activities and their effectiveness, helping to guide management action prioritisation for this WAP.

1.5 The Yarriambiack Creek WAP structure

This WAP is structured as follows:

Section	Content
Section 1	Background
Section 2	Catchment overview
Section 3	Waterway and vegetation condition assessments
Section 4	Management strategy
Section 5	References
Attachment A	Vegetation species list
Attachment B	Waterway condition data
Attachment C	Prioritised actions

2 Catchment overview

2.1 Geomorphic context

Waterways and floodplain

The Yarriambiack Creek is situated in the southern Mallee and northern Wimmera regions of western Victoria. As a natural distributary, the creek diverges from the Wimmera River at the effluence near Longerenong and flows 120 km almost directly north through Jung, Warracknabeal, Brim and Beulah before discharging into Lake Coorong, south-east of Hopetoun. The Yarriambiack Creek experiences prolonged periods of no or low flow for several years at a time, with water only reaching Lake Coorong in very high flows, the most recent being during the Spring 2016 floods.



Figure 3. *Yarriambiack Creek at the upper catchment looking downstream away from the Wimmera River (March 2018).*

Yarriambiack Creek and Dunmunkle Creek to the East are hydrologically rare systems within south-east Australia, both being distributaries, flowing away from the more major Wimmera River. These waterways may have once been the Wimmera River channels and have similar form to both the anabranching, fine-grained flood channels of the Wimmera River and the Wimmera itself. However, both Yarriambiack and Dunmunkle Creeks are slowly filling with fine sediment and losing their original form.

There are three distinct geomorphic regions in the Yarriambiack Creek catchment (Figure 4). The upstream reach to the south extends from the Wimmera effluence to around Jung Weir with almost continuous water observed. From Jung Weir north to Warracknabeal, the Creek flows less frequently, with water only present in weir pools during field inspections. The northern extent of the Creek only receives water in very high flows events, with little to no water observed. These three regions are described in further detail below.

The catchment has one existing gauge (415241) at Murtoa, downstream of the Wimmera Highway, however readings are infrequent between 1978-1983 and 2010 to present.

Geology and sediments

The course of the Yarriambiack Creek is largely influenced by north-south trending ridges and troughs associated with former shorelines (Earth Tech, 2007). During the Tertiary period, a series of marine transgressions occupied much of the lower Murray Basin. Extensive Parilla (marine) sands were laid down across the Wimmera plains. These marine transgressions left a series of north – south trending strandline

ridges (representing former shorelines). The Wimmera River, Yarriambiack Creek and Dunmunkle Creek all now flow north in the alignment of the corresponding troughs (EarthTech 2003).

The geology of Yarriambiack Creek mainly comprises of sand and dune deposits. In the upper (southern) catchment clay soils are reflective of the older alluvial plains of the Wimmera River. Moving north, the mid-catchment is made up of newer alluvial deposits underlain by sandstone and coastal dune deposits. The northern, lower catchment geology comprises both lake and dune deposits.

Yarriambiack Creek flows through two major bioregions, the Wimmera and Murray Mallee. The Wimmera bioregion is characterised by relatively flat to gently undulating plains (DSE, 2004b). Plains Woodland, Plains Grassy Woodland, Plains Grassland, Red Gum Wetland and Grassy Woodland are the dominant ecosystems. The Murray Mallee bioregion is typified by broad undulating sandy plains (DSE, 2005). Vegetation is dominated by East/West-Dune Mallee with some Chenopod Mallee and Shallow-Sand Mallee.

Stream types

Yarriambiack Creek has been described as a low sinuosity, alluvial channel and an anabranching system in the advanced stages of abandonment (EarthTech 2007). Waterways in the upper (southern) catchment receive the highest amounts of water and have a geomorphic form close to that of the Wimmera River. Channel widths range from around 30-40 metres, with depths of around 3.5 to 4 metres. This reach has maintained its deeper geomorphic form as more flows pass, with the channel also being maintained by substantial return flows back to the Wimmera as floodwaters recede (EarthTech 2007).

Downstream (north) of Darlot Swamp, the creek takes the form of a wide (30-100m) and shallow (0.5-1.5m) depression within a broad (around 1.5 km), shallow valley. At the time of field inspection, water was present in storages along the creek, however no flowing water was observed. North of Warracknabeal, the Creek meanders on an alluvial floodplain within a narrow channel. Water rarely flows to this section and high flows spill out over the broad floodplain. In very high flow events, the last of which being in Spring 2016, floodwaters flow into Lake Coorong.

Drainage channels and levee banks have been constructed along the Yarriambiack Creek to fill adjacent dams for stock and domestic uses. In addition to these smaller excavated dams, substantial weirs have been constructed at Jung, Warracknabeal, Brim and Beulah. These weir pools provide recreational value to the area and are popular for water skiing (EarthTech 2007).

Channel stability

Overall, waterways across the Yarriambiack Creek catchment are relatively stable, with little erosion evident. This is a result of the low flow volumes the Creek receives, with the majority of high flows dissipating into Darlot swamp, other storages, or over the floodplain, therefore reducing flow velocity and erosion potential in the channels. The primary threats to the Creek's health are declines in native vegetation, woody debris and increased weed and pest infestations. As a channel in the advanced stages of abandonment, the morphology of the Yarriambiack is not threatened by reach-scale incision.

However, changing land management practices since European settlement have influenced channel form and stability on a site scale. Channel destabilisation from either wind-blown or water erosion may increase with stock movement on the banks and in the bed of the channel. Numerous weirs, road crossings, dams and structures present along the Creek also have an impact on localised stability. Yarriambiack Creek does not appear to have been majorly channelised with a low potential for incision. Some localised scour has previously been reported in channelised sections, around culverts, in weir low flow channels and stormwater outlets.

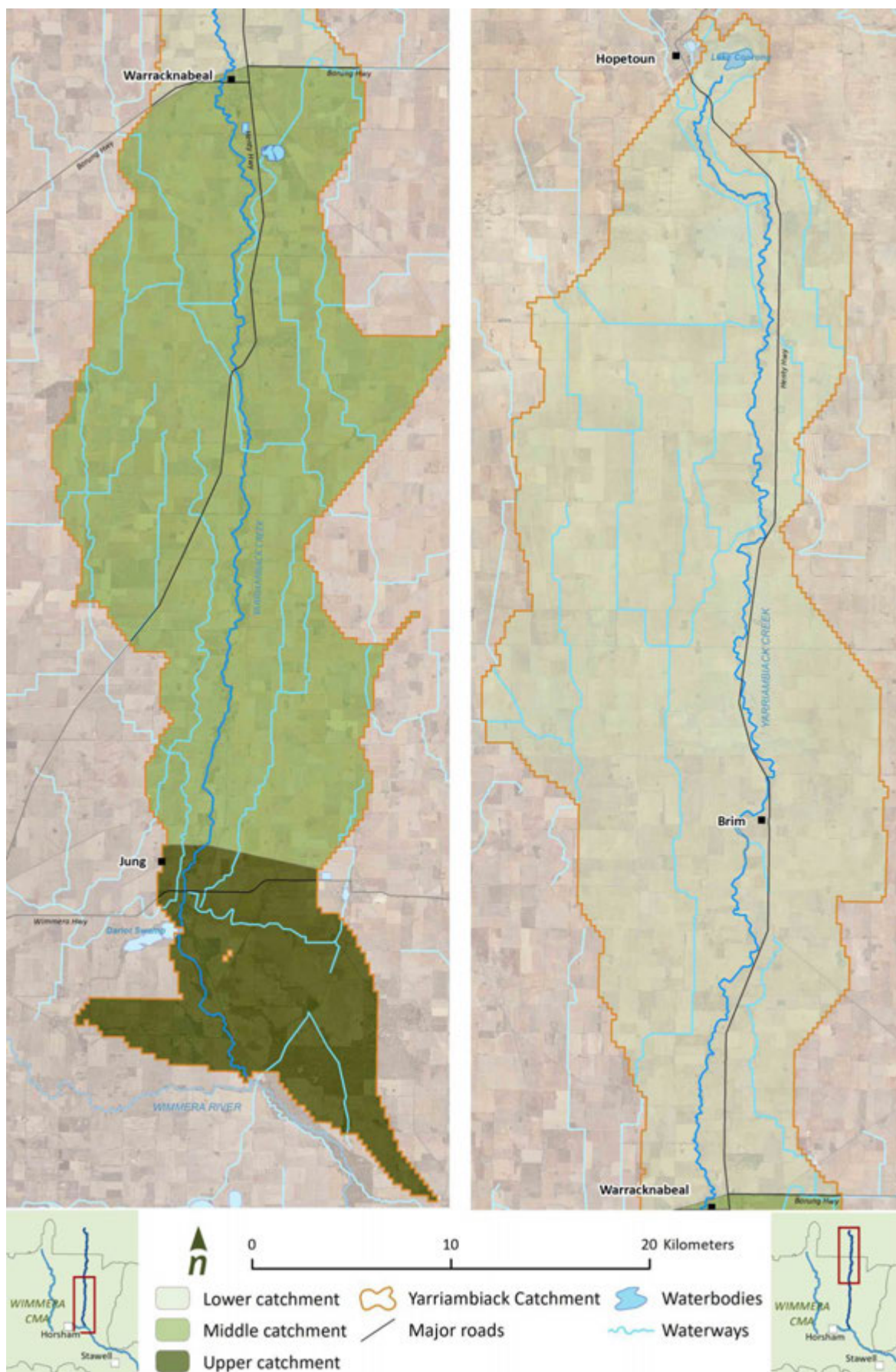


Figure 4. Yarriambiack Creek Catchment delineation, waterways and waterbodies

2.2 Catchment land use

Historical changes and pressures

Open forest and woodlands originally covered the Wimmera Plains, made up of Yellow Gum, Buloke, Black and Grey Box with large natural grassland areas between. Further north, the Mallee plain woodlands consisted of Mallee Eucalypts, Black Box, Yellow Gum, Buloke and Slender Cypress Pine. The river was fringed with River Red Gum and Black Box with an understorey of wattles, grasses, sedges, saltbushes and Lignum (YCAC, 2004).

Grazing and livestock production, primarily sheep and cattle, dominated the Yarriambiack area up to the 1870s in the south and into the 1880 and 1890s in the mid- to northern-catchment. After this time, the Wimmera area became one of Australia's major grain production regions, particularly for wheat growing (Context, 2012). Following expansion of railways in the 1880s and 1890s by 1900, most of the Wimmera was cleared for either wheat production or grazing. Further development of machinery and more efficient farming practices in the 1930-50s saw a decline in labour needs and population, with larger and fewer farms (Context, 2012).

These changes in farming practices, along with droughts, bushfires and pest species (rabbits in particular) have had a range of environmental, social and economic impacts on the catchment. Between the late 1880s and 1940s there was a spike in rabbit populations and a series of rabbit plagues - the most notable occurring post-World War II. Rabbit plagues were largely controlled with the introduction of the myxoma virus in the 1950s. Figure 5 provides a snapshot of historical land use change in the Yarriambiack Creek catchment.

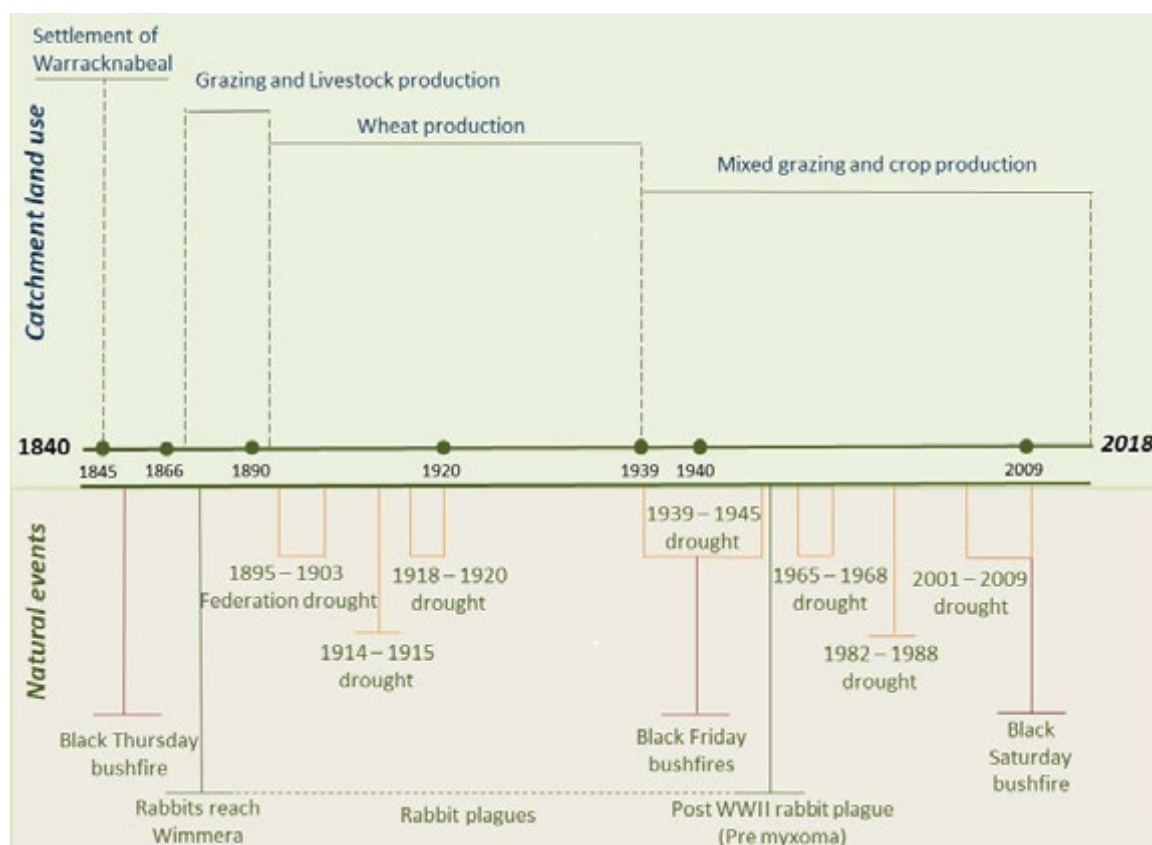


Figure 5. Historical catchment land use change, extreme climatic events and pest infestations within the Yarriambiack Creek catchment and broader Wimmera-Mallee area.

Current land use

The majority of the catchment is used for mixed farming, cropping and grazing, with residential housing concentrated around the township of Warracknabeal and other smaller towns (Figure 6). The intensity of grazing is relatively low, with some landholders no longer actively farming the land, and/or residing only part-time.

The Yarriambiack Shire dry-land farming area now produces one quarter of Victoria's total production of wheat and barley, as well as producing lamb and wool (YSC, 2015). Legumes and oilseed crops have also become important alternatives to livestock production. The 2004 Yarriambiack Creek Management Plan estimated that less than 2% of original vegetation remains on the Wimmera and Mallee Plains, highlighting the importance of the Yarriambiack Creek corridor (YCAC, 2004).

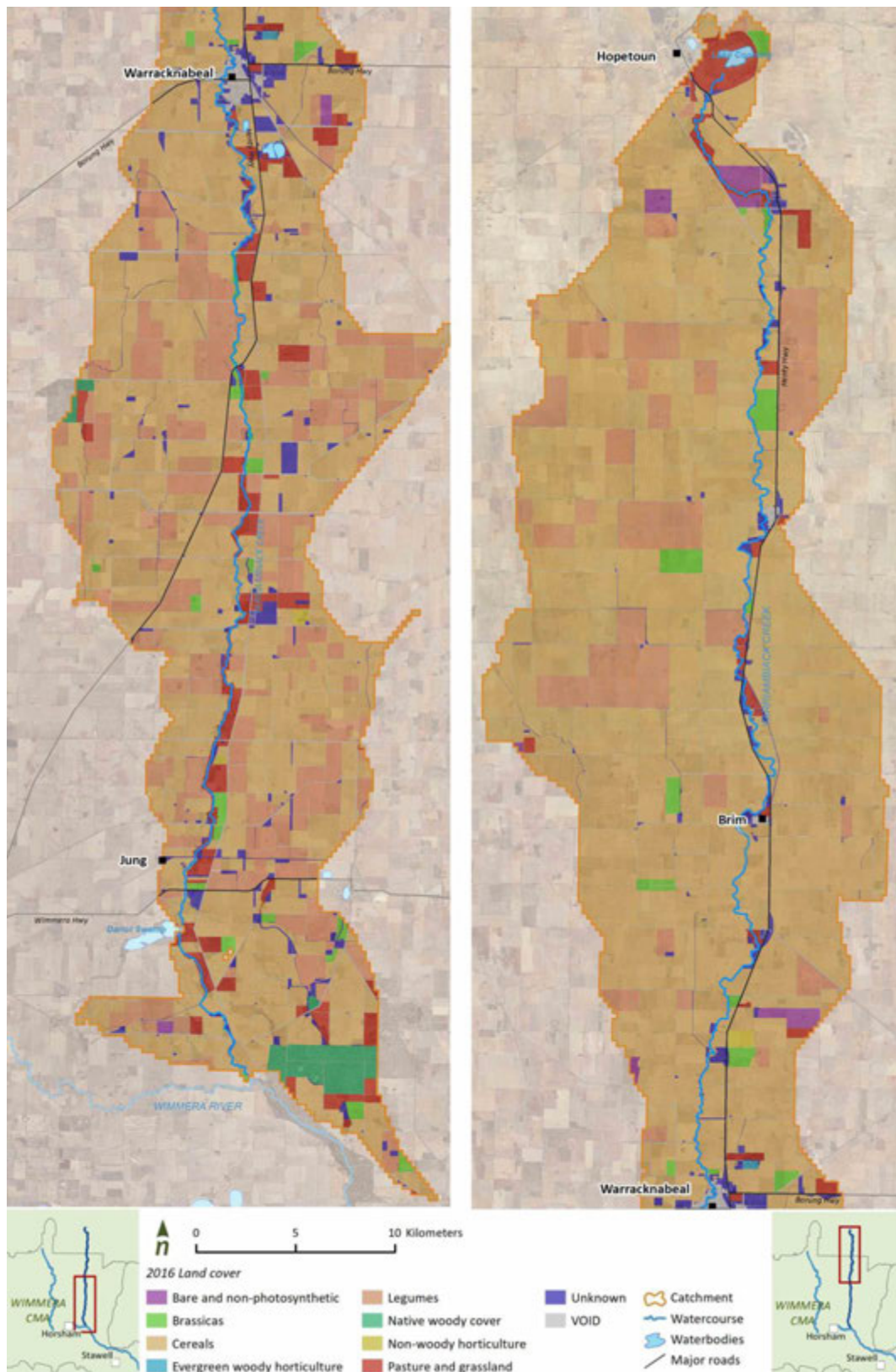


Figure 6. 2016 land cover in the Yarriambiack Creek catchment (DEDJTR 2016)

2.3 Flora and fauna

The Yarriambiack Creek provides a valuable link for native flora and fauna in an area largely cleared for agriculture. The intermittent flows of the Yarriambiack Creek support some rare floral and faunal associations. After clearing during European settlement for agricultural purposes, remnant vegetation is now scattered throughout the catchment, but mostly associated with road reserves and the riparian corridor (Figure 7, Figure 8).

As noted previously, the two bioregions spanning the catchment are:

- Wimmera Bioregion: includes the upper and middle catchment from the effluence to Warracknabeal
- Murray Mallee Bioregion: includes the lower catchment from Warracknabeal to Lake Coorong.

Within the Wimmera Bioregion, the most extensive Ecological Vegetation Class (EVC) is Low Rises Woodland, typically consisting of Eucalypt woodland up to 15 metres tall on elevated plains and low rises, with a diverse shrub understorey and grassy field layer (Table 2). This EVC results from well-drained surface soils mantling clay sub-soils. Within the Murray Mallee Bioregion, the dominant EVC is Riverine Chenopod Woodland, supported by heavy clay soils and consisting of Black Box (*Eucalyptus largiflorens*) woodland and a diverse shrubby and grassy understorey occurring on most elevated riverine terraces.

Table 2. Ecological Vegetation Classes within the Yarriambiack Creek Catchment

Bioregion	EVC name	Bioregional Conservation Status	Area (ha)
Wimmera	Cane Grass Wetland	Vulnerable	4
	Freshwater Meadow	Endangered	15
	Grassy Woodland	Endangered	218
	Heathy Mallee	Least Concern	3
	Lignum Swampy Woodland	Vulnerable	1001
	Low Rises Woodland	Endangered	2319
	Parilla Mallee	Endangered	135
	Plains Grassland	Endangered	148
	Plains Savannah	Endangered	1271
	Plains Woodland	Endangered	1084
	Red Gum Swamp	Vulnerable	70
	Ridged Plains Mallee	Endangered	772
	Riparian Woodland	Vulnerable	180
	Riverine Chenopod Woodland	Endangered	874
	Sand Ridge Woodland	Endangered	115
	Semi-arid Woodland	Vulnerable	5
	Shallow Sands Woodland	Vulnerable	142
	Woorinen Mallee	Vulnerable	6
Murray Mallee	Lake Bed Herbland	Depleted	508
	Lignum Swampy Woodland	Vulnerable	1703
	Low Chenopod Shrubland	Depleted	6
	Low Rises Woodland	Endangered	126
	Parilla Mallee	Endangered	90
	Plains Savannah	Endangered	733
	Plains Woodland	Endangered	206
	Ridged Plains Mallee	Endangered	1101
	Riverine Chenopod Woodland	Depleted	2518
	Semi-arid Chenopod Woodland	Vulnerable	2
	Semi-arid Woodland	Vulnerable	23
	Woorinen Mallee	Vulnerable	84

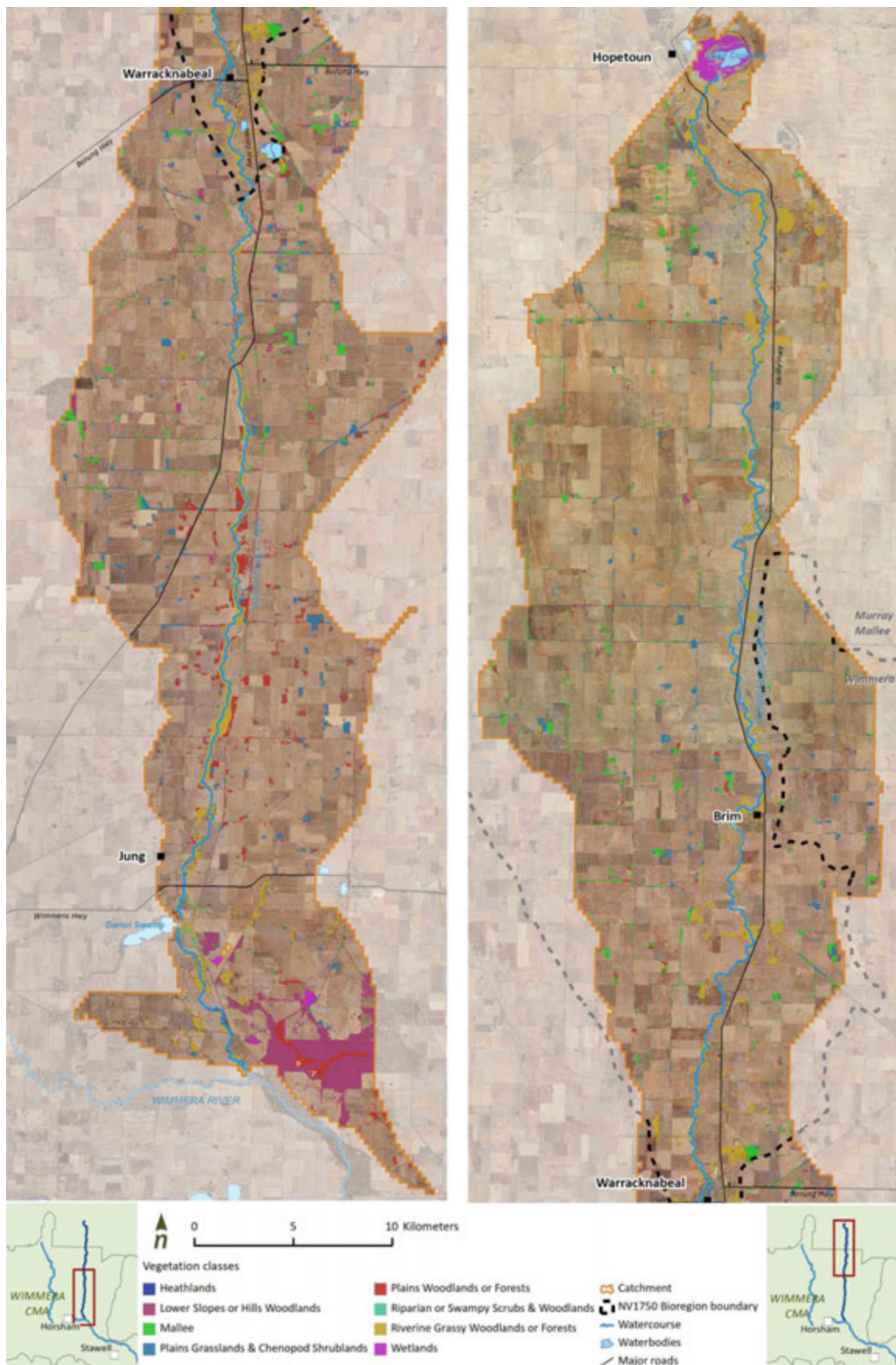


Figure 7. 2005 modelled native vegetation Ecological Vegetation Classes (EVCs) in the Yarriambiack catchment. 1750 bioregion boundary between the Wimmera and Murray Mallee delineated by dotted line.

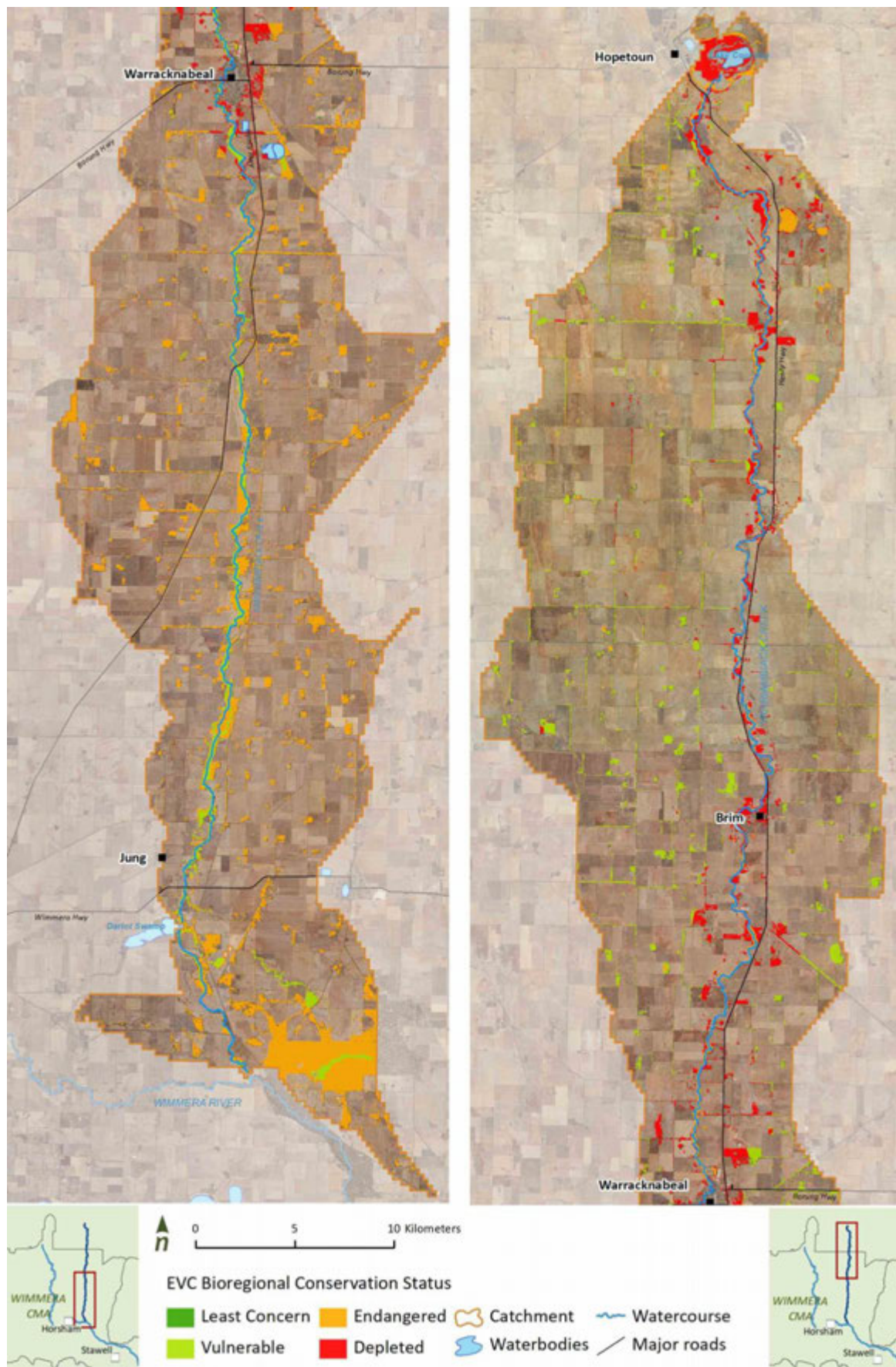


Figure 8. 2005 native vegetation Bioregional Conservation Status (BCS) in the Yarriambiack Catchment

Vegetation condition is relatively uniform throughout the catchment, with pockets of higher quality vegetation in localised areas. Nearer townships, homesteads and road/railway reserves, weed coverage is significantly higher. In areas of intense grazing, vegetation condition deteriorates, with generally lower diversity of understorey vegetation and reduced regeneration.

Significant flora

The waterway and surroundings (5 km buffer area) support a number of national and state significant flora species. On the Victorian Advisory lists, the project search area includes records of 13 vulnerable, 35 endangered and 3 poorly known species. Three species in the search area are also listed under the *Environment Protection and Biodiversity Conservation Act 1999*, these are:

- Slender Darling-pea *Swainsona murrayana* (Endangered)
- Winged Pepper-cress *Lepidium monoplocoides* (Endangered)
- Floodplain Rustyhood *Pterostylis cheraphila* (Vulnerable)

During field inspection, a population of Prickly Bottlebrush *Callistemon brachyandrus*, was also recorded, the first record for this region, with the only other records for this species in Victoria being around Hattah Lakes and the adjacent Murray River.

Existing revegetation works

Landholders, Landcare and Greening Australia networks have undertaken extensive planting projects within sections of the catchment, including the Yarrilinks Plantings, Roma Ross Reserve and the Yarriambiack Vegetation Enhancement Project. These plantations are in a range of condition states, depending on the status of fencing for exclusion of stock. Fenced sites typically show good survival of trees and shrubs, with some signs of ongoing natural regeneration.

Overall, the health of the flora in the Yarriambiack Creek reserve is excellent, with the dominant overstorey of Black Box *Eucalyptus largiflorens* and River Red Gum *Eucalyptus camaldulensis* being very healthy, despite the ongoing extremely dry conditions.

Weeds

As with all modified agricultural landscapes, the catchment has a range of problem weeds. Weeds were particularly prevalent in road or railway reserves and near homesteads (either current or previous) or rubbish dump sites (e.g. Lah and Jung tips). The following weeds were particularly common during field inspections, and highlighted by landholders during the community information sessions:

Horehound *Marrubium vulgare* is widespread throughout Victoria and is common in sheep grazing areas and waste lands. It thrives on poor soil and invades pastures as it is unpalatable for grazing livestock. Horehound burrs contaminate wool and if ingested, taints the meat of animals for up to 7 days.

Spear thistle *Cirsium vulgare* is a very common environmental weed found in pasture, along roadsides and in wasteland. It is highly invasive and is common in moist lands, depressions and swamps, but does not survive prolonged inundation.

Common Heliotrope *Heliotropium europaeum* was introduced to Australia in the 19th Century and thrives on disturbed, bare, open or cultivated ground. Heliotrope has enormous seeding potential, with seeds remaining viable for many years. Heliotrope contains toxins and can be fatal to grazing animals, particularly sheep.

African Boxthorn *Lycium ferrosissimum* is a fast-growing invasive species that, if untreated, spreads quickly. African boxthorn prefers dry, light soils, waterways and neglected areas such as roadsides and railway reserves. Broken roots and cut stumps can sprout regrowth.

Common Prickly Pear *Opuntia stricta* and **Wheel Cactus** *O. robusta* grow mainly along streams and banks, where they encroach into adjoining grazing land. They are drought resistant and do not burn easily. Seeds are dispersed when fruit drops to the ground and takes root or over longer distances

through animal droppings or by flood waters. Small segments of fruit can also attach to wool, footwear and tyres of passing vehicles. Once established, individual plants can live for several decades.

Bridal Creeper *Asparagus asparagoides* is a Weed of National Significance and regarded as one of the worst weeds in Australia due to its invasiveness, potential for spread and economic and environmental impacts. Rare native plants such as the rice flower are threatened with extinction by bridal creeper

Prickly Lettuce *Lactuca serriola* is widespread in drier areas of Victoria but is often found on the margins of swamps and lakes, on roadsides and in gardens and crops. It appears to have some salt tolerance.

Significant fauna and pests

The catchment contains a diverse range of fauna habitats, including grassy woodlands, plains woodlands, riparian corridors, grasslands and wetlands. On the Victorian Advisory lists, the project search area includes records of 30 near threatened, 36 vulnerable and 16 endangered species. Four nationally threatened species are also listed under the *Environment Protection and Biodiversity Conservation Act 1999*, these are:

- Growling Grass Frog *Litoria raniformis* (Vulnerable)
- Eastern Curlew *Numenius madagascariensis* (Critically Endangered)
- Australasian Bittern *Botaurus poiciloptilus* (Endangered)
- Mallee Emu-wren *Stipiturus mallee* (Endangered)

The Creek surrounds are also known to support habitat suitable for the Pale Sun Moth, Bush Stone Curlew, Grey-Crowned Babbler, Grey Flacon, Australian Bustard and Hooded Scaly-Foot. During field inspection, several black wallabies *Wallabia bicolor* were observed, along with a Barn Owl *Tyto alba* and a Hooded Robin *Melanodryas cucullata*.

Ecological connectivity

Ecological connectivity is a key driver for regional stakeholders in the area between the Wimmera and Mallee bioregions and is therefore a focus of this WAP. The Yarriambiack corridor provides a habitat link between, not only the larger Wimmera and Mallee Regions, but between major areas of native vegetation at Wyperfeld, Little Desert and the Grampians National Parks. On a more local scale, the Creek links Darlot Swamp, Barrabool Flora and Fauna Reserve and Lakes Coorong and Lascelles during flood.

2.4 Existing fencing

As part of this WAP investigation, the extent of riparian fencing across the catchment has been recorded (Figure 9). Waterways are largely fenced both sides in areas that are at risk of impact from stock or other disturbances, however stock access in the channel is still an issue (see below). In other areas, where cropping is the dominant farming practice, waterways have minimal impact from stock or human access, and so fencing is less critical (and for the present time deemed not applicable). There is an opportunity now to fill some gaps in the fenced riparian corridors across the catchment with the objective of contributing to improved overall waterway health and enhanced connectivity of these corridors from the upper to the lower catchments.

2.5 Stock access

Although the majority of the waterway is fenced, the riparian reserve itself has, in some areas, been used as a grazing area for stock. This practice was particularly apparent in the upper and mid-catchment. The high impact of this localised, intensive grazing is evident in the lack of regeneration and reduced shrub understorey. This results in reduced connectivity and diversity as well as increased risk of bank erosion and weed invasion. In-channel stock grazing represents a significant opportunity to improve river health through low-cost management action. In the majority of these areas, new or improved fencing is not required and significant improvement in river health can be achieved through altered grazing practices.

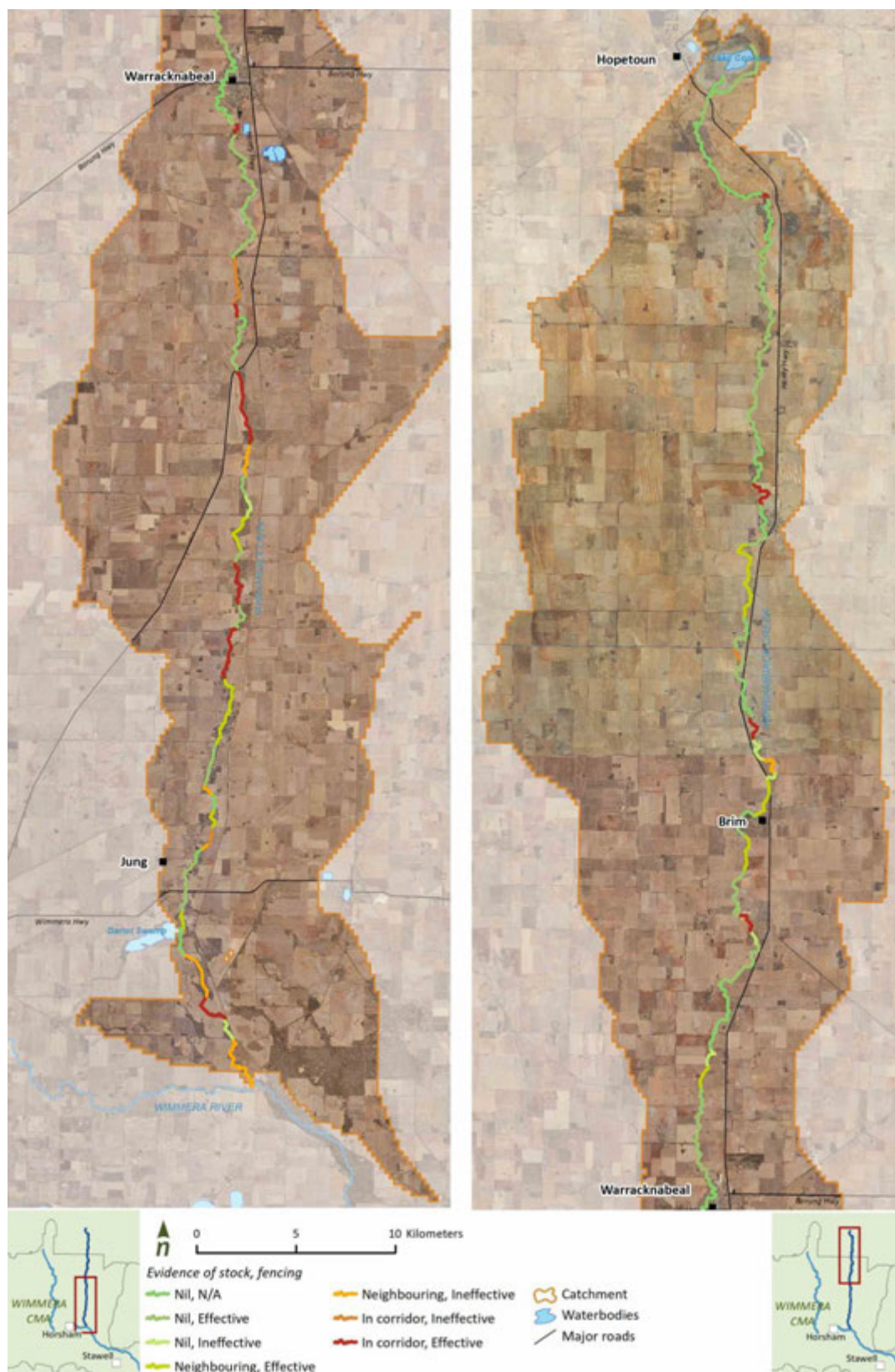


Figure 9. Indicative stock and fencing status across the Yarriambiack Creek catchment.

3 Waterway and vegetation condition

This section provides an overview of waterway and vegetation condition across each of the upper, mid and lower catchment zones in the Yarriambiack Creek catchment. Observations noted here are based on desktop and field data collected during the assessment. A summary of observations is provided below for each zone, and detailed data is provided in Attachment B and as a spatial database provided with the report.

3.1 Upper catchment

The upper catchment zone (Figure 10) is located downstream of the Wimmera River effluence, through to Jung Weir (site YAR001 to YAR011), including Darlot Swamp (DAR001).

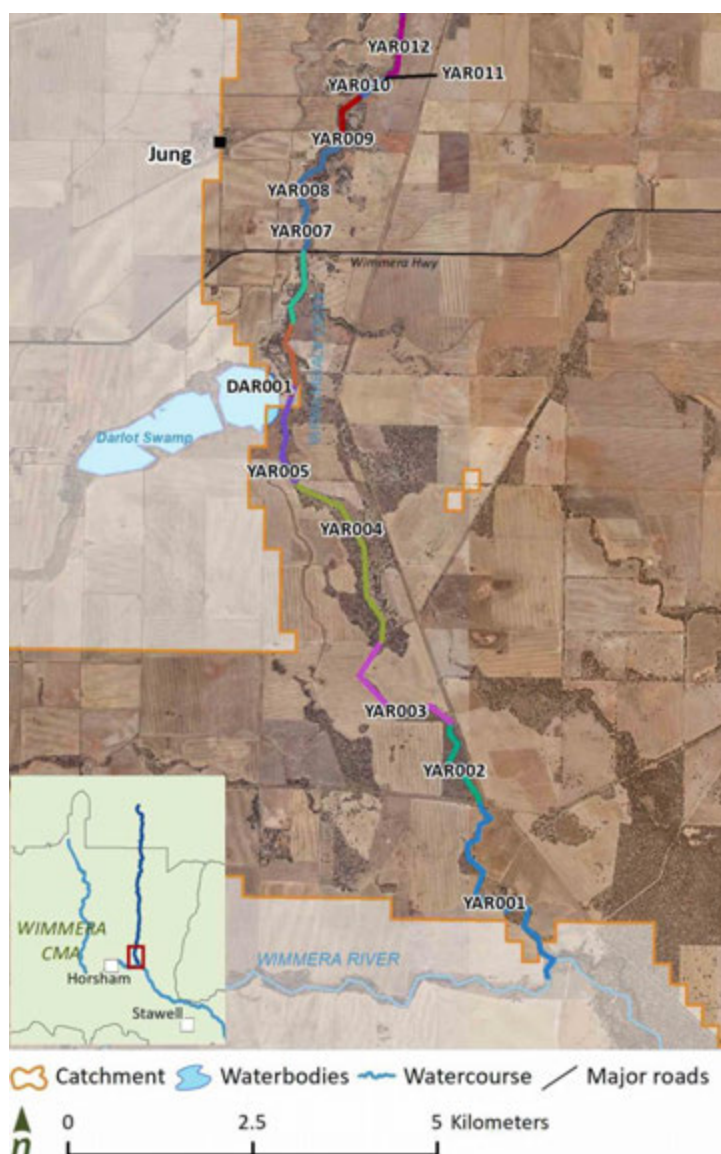


Figure 10. Upper catchment site locations and delineation from the effluence of the Wimmera River to Jung Weir.

Waterways

The creek just downstream of the effluence (Figure 11, Figure 12), has geomorphic form close to the Wimmera River with 35 to 45-metre channel widths and 3.5 to 4-metre channel depths. This more defined channel is most likely a result of higher and more frequent flows passing through this reach, before dispersing into Darlot Swamp and other catchment storages. In high flow events, once Darlot Swamp overflows, water continues to the south along Two Mile Creek, and returns to the Wimmera River. As the floodwaters of the Wimmera River

recede, this reach would also be subject to return (upstream) flows. This flow reversal may minimise deposition and assist with maintaining channel form. This reach has been described previously as a perched stream, however levees present in the upper reaches appear to be constructed to reduce flooding and improve water conveyance.

Minimal evidence of rabbit infestations was found in this southern reach, reflective of the clay soils which are less suitable than the northern sandier soils for burrowing. Stock access and grazing within the corridor is a significant issue between the effluence and Darlot Swamp, although steeper banks somewhat protect the immediate riparian zone from grazing pressure.



Figure 11. Yarriambiack Creek effluence, with the Wimmera River flowing left to right, the effluence in the centre and Yarriambiack Creek flowing towards the bottom left (site YAR001).



Figure 12. Yarriambiack Creek upper catchment – view upstream showing well defined channel towards the effluence with the Wimmera River (site YAR002)



Figure 13. Yarriambiack Creek upper catchment – view downstream along well-defined channel with water ribbons (site YAR004)

Scour at Jung Weir is evident with water outflanking the concrete bypass and scouring out behind the existing geofabric. Works are recommended to remove the smaller trees in the channel and carry out repairs to stabilise the banks.



Figure 14. Left: low flow bypass at Jung weir looking downstream, Right: scour of low flow bypass right bank (YAR011)

Vegetation

The upper reach shows clear evidence of regular flows, with the only occurrences of the Common Reed *Phragmites communis* recorded as dense strands along the creek bed in this reach. Also recorded in this reach was Willow Wattle *Acacia salicina*, an uncommon species in the Wimmera.



Figure 15. Common Reed *Phragmites communis* at the Yarriambiack Creek effluence with the Wimmera River (YAR001)



Figure 16. Grazed banks just downstream of Longerenong Road (Site YAR002)

A number of exotic weed species were also only recorded in this section, including Wild Asparagus *Asparagus officinalis*, Sweet Briar *Rosa rubiginosa* and Cape Honey Flower *Melianthus major*. These have most likely emanated from the nearby extensive exotic gardens of Longerenong Homestead.

To the north of Longerenong Homestead there are extensive stands of Narrow-leaf Cumbungi *Typha domingensis* growing in along and in the creek bed. The 2006 Wimmera Waterway Action Plan highlighted community concern over the encroachment of this vegetation into the channel and a decrease in channel capacity. However, this native reed is an important habitat plant for migratory Reed Warblers, as well as creating a dense refuge for other wildlife to travel along the creek frontage. The only occurrences of Southern Water Ribbons *Triglochin alcockae*, Common Water Ribbons *Triglochin procera*, Pondweed *Potamogeton sp.* and aquatic emergent water plants were also recorded in this section. These species, along with Cumbungi and *Phragmites* require regular water flows to survive and prosper.

Riverine Pale Anther Flax-lily *Dianella sp nov aff longifolia* 'Riverina' (Figure 17), listed as vulnerable in Victoria (DELWP), was also found in this reach along with the only record for the survey of the closely related Black Anther Flax-lily *Dianella admixta*.

The original streamside tree cover has largely been removed many years ago throughout the upper section of the creek reserve, making the reedbeds along the creek even more important for wildlife migration. This section warrants funding to restore the original tree cover along the creek corridor.



Figure 17. Left: Riverine Pale Anther Flax-lily *Dianella sp nov aff longifolia* 'Riverina' Photo: David Francis. Right: Squirting Cucumber *Ecballium elaterium* close to the old Jung tip

The creek reserve around Jung is a serious hotbed for invasive exotic weeds, with the only outbreaks for the survey of Squirting Cucumber *Ecballium elaterium* (Figure 17), Paspalum grass *Paspalum dilatatum* and Desert Ash *Fraxinus angustifolia*. On the other hand, the weir pool at Jung provided good habitat for a number of aquatic native species including Slender Spike-rush *Eleocharis gracilis*, Water Milfoil *Myriophyllum sp* and Eel Weed *Vallisneria spiralis*. The White Poplars *Populus alba* planted at the weir (Figure 18) are suckering and spreading, but at this stage are not showing evidence of becoming a threat, although, long term it would be wise to have them removed.



Figure 18. White Poplars *Populus alba* planted along Jung Weir (YAR011)

3.2 Middle catchment

The mid-catchment zone runs from Jung Weir to Warracknabeal (YAR012 to YAR046, Figure 20)

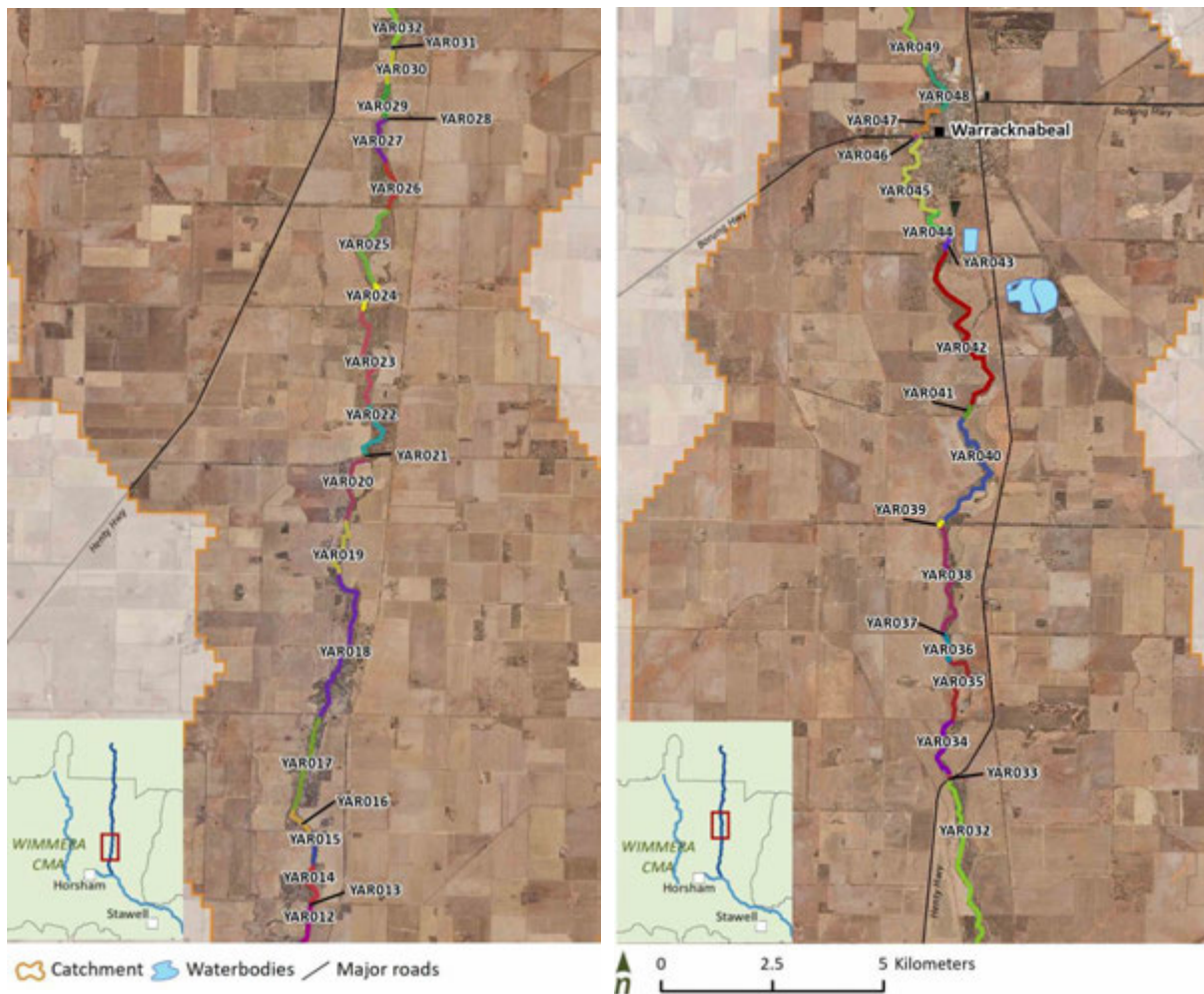


Figure 19. Site locations and delineation for the mid catchment area south of Jung Weir to Warracknabeal.

Waterways

Waterways across the mid-catchment are much shallower than upstream and take the form of a slight depression within a wide floodplain. Channels are around 30-100 metres wide and 0.5 to 1.5 metres deep, with some minor anabranches. Waterways in this zone are more heavily impacted by stock than in the lower reach, with in corridor grazing being major threat to waterway health. Complete removal of understorey species through intense grazing exposes soil to both fluvial and aeolian erosion.



Figure 20. Wide, shallow channel form, looking downstream from Drillers Road (YAR020), typical of the mid catchment. This area appeared to be run as a grazing paddock, with little understorey vegetation.

Towards the northern end of this reach, rabbit warrens became evident reflecting the progressively sandier soils as you move towards into the Murray Mallee Bioregion. The largest town in the catchment Warracknabeal is located within this reach, with a large weir pool and significantly more water available than downstream.

Stocking within the channel is highest in the mid-catchment, with many areas of the Creek corridor being run as grazing paddocks, although fencing is present. This may be due to the greater availability of water than further upstream and reduced need for stock water troughs. Minor, localised scour is evident around some culverts, however there is no evidence of large scale instabilities.

Vegetation

Downstream of Jung Weir, it is evident from the flora that there are still occasional water flows through this section, with a number of native water dependant species evident, although in far lower concentrations than south of the weir. As well as continuing large stands of Narrow-leaf Cumbungi *Typha domingensis*, other notable native species recorded were stands of Southern Cane-grass *Eragrostis infecunda*—a regionally rare aquatic grass species, along with Lesser Joyweed *Alternanthera denticulata* and Common Sneezeweed *Centipeda cunninghamii*. This was one of the few locations where this species was recorded along the Creek.

This mid-section of the creek supports superb areas of Buloke *Allocasuarina leuhmannii* Woodland. This community is listed under the EPBC Act as a threatened community. Most stands also supported rich native grassy woodland ground flora with species such as Blue Devil *Eryngium ovinum*, Scented Matrush *Lomandra effusa*, Bluebush *Maireana* sp, Pink Mulla *Mulla Ptilotus exaltatus*, Variable Sida *Sida corrugata* and Quena *Solanum esuriale*. This makes these sites some of the most important Buloke woodland remnants remaining in the Wimmera. There are also very important grassy woodland remnants growing with the dominant Black Box *Eucalyptus largiflorens* and Red Gum *Eucalyptus camaldulensis* overstorey.



Figure 21. Black Box *Eucalyptus largiflorens* over native grassland

The mid-catchment also supports two stands of a new weed for the region Chigma Lantern *Abutilon theophrasti*. This is only the 2nd and 3rd record for the Wimmera of this invasive species, previously only recorded for the region at Natimuk.



Figure 22. Outbreak of the highly invasive Chigma Lantern *Abutilon theophrasti* in creekbed south of Drillers Road (YAR019).

From around the Banyena-Pimpinio Rd, the decline in aquatic flora, particularly species such as Narrow-leaf Cumbungi *Typha domingensis* indicate the normal limit of seasonal creek flows. None of these types of water plants were found north of this point, apart from around the permanent weir pools such as at Warracknabeal and Beulah.

In this reach Brown Treecreepers were common. This bird species is listed as part of EPBC listed Woodland Bird Community. It indicates again, that the Yarriambiack Creek reserve is of considerably high value for threatened flora and fauna.

Around the township of Warracknabeal, a disturbing record was numerous outbreaks of cactus and succulent weeds. This included Common Prickly Pear *Opuntia stricta* and Wheel Cactus *Opuntia robusta*, both of which are now declared Weeds of National Significance (WONS).

3.3 Lower catchment

The lower catchment from Warracknabeal to Lake Coorong includes sites YAR047 to YAR097 and COR001 to COR004 (Figure 24).

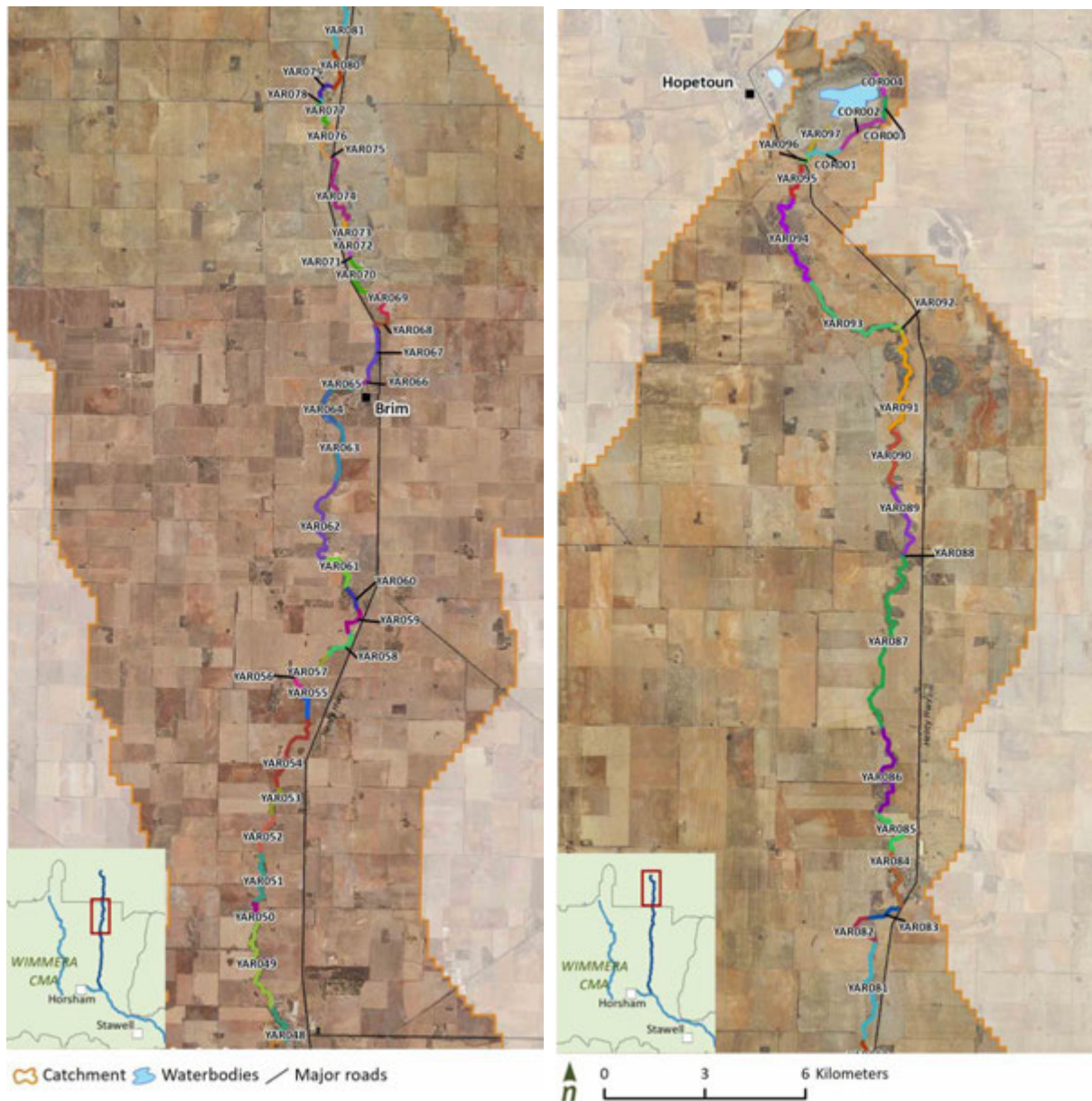


Figure 23. Site location and delineation for the lower catchment from Warracknabeal to Lake Coorong, near Hopetoun.

Waterways

Waterways across the lower catchment (north of Warracknabeal) are relatively shallow and well engaged with the floodplain. Water rarely reaches this area and during flood events, water dissipates across the floodplain via many channels and depression lines, characteristic of lowland sandy plains. Aeolian processes have a progressively stronger influence on channel form downstream of Warracknabeal.

In much of the reach, a low flow channel has been constructed to better facilitate water distribution, with channels and levees constructed in isolated locations to mitigate flooding or fill adjacent dams. Prolific rabbit infestations were found throughout the northern reach, reflective of the sandy soils found in the Mallee region. Evidence of rabbit poisoning and management activities was also widespread.



Figure 24. Prolific rabbit infestations in the northern catchment at Goyura West Road (YAR091 and YAR092)

The majority of the waterway in the lower catchment has been fenced or is within cropped land with relatively low impact of stock (Figure 25). However, isolated pockets of stocking within the corridor need to be addressed (Figure 26).



Figure 25. Looking downstream of the Henty Highway crossing near Ryans Road (YAR076). This area has no stock access and is in excellent condition with a densely vegetated riparian corridor 2-3 km downstream of Baums Road (above figure).



Figure 26. A heavily stocked area looking upstream from Baums Road (YAR072). The very wide, shallow channel has been utilised as a grazing paddock, with very little vegetation growth or ground cover.

Minor, localised scour is evident around some culverts (Figure 27), however there is no evidence of large scale instabilities. Due to low flow volumes in this area of the creek, erosion is unlikely to liberate large quantities of sediment downstream and will remain localised. While remediation of culverts will not greatly improve river health, if structures become significantly unstable or unsafe, these works may become a higher priority.



Figure 27. Scour downstream of culvert (left) and tunnelling at Galaquil West Road (right) (YAR078).

Vegetation

The lower reach features many of the inland native plant species that become common as you move out of the Wimmera and into the Mallee region. Common plants recorded include Grey Mulga *Acacia brachybotrya*, Mallee Wattle *Acacia montana*, Slender Cypress-pine *Callitris gracilis*, Hooked Needlewood *Hakea tephrosperma* and Weeping Pittosporum *Pittosporum angustifolium*. Also recorded in this section was another population of *Dianella sp nov aff longifolia* 'Riverina'—listed as vulnerable in Victoria (DELWP).



Figure 28. Natural vegetation recruitment in background in an area of no stock grazing, upstream of Windy Ridge Road (YAR090).

Of concern around the township of Brim and near the old Lah tip site were a number of serious invasive weeds along the creek reserve. Of particular note were Bridal Creeper *Asparagus asparagoides*, African Box-thorn *Lycium ferrosissimum*, Canary Island Date Palm *Phoenix canariensis* and Common Prickly Pear *Opuntia stricta* (Figure 29).



Figure 29. Common prickly pear infestations near Brim weir pool (left) and Lah Tip, south of Lah West Road (right)

In this reach Hooded Robins and Brown Treecreepers were common, both of which are listed as part of EPBC listed Woodland Bird Community.

Other notable inland plants found in this section include numerous plants of Umbrella Mulga *Acacia oswaldii* which is a regionally rare species. Another extremely significant record for this section was the discovery of a population of Prickly Bottlebrush *Callistemon brachyandrus*, the first record for this region. The only other records for this species in Victoria are around Hattah Lakes and the adjacent Murray River.



Figure 30. Prickly Bottlebrush *Callistemon brachyandrus* on the banks of the Yarriambiack Creek

Large outbreaks of a number of invasive weeds are found throughout this reach, notably Spear Thistle *Cirsium vulgare* (Figure 31), Common Heliotrope *Heliotropium europaeum*, Prickly Lettuce *Lactuca serriola* and Horehound *Marrubium vulgare*. Most are located adjacent to human occupation or human disturbance such as road crossings.



Figure 31. *Spear thistle infestation in the northern catchment area at Roseberry-Rainbow Road (YAR088).*

A large range of inland native plants are found at the mouth of the Yarriambiack Creek, where it flows into Lake Coorong. Of interest were the occurrence of good populations of Native Liquorice *Glycyrrhiza acanthocarpa*, Short-leaf Bluebush *Maireana brevifolia*, Tangled Lignum *Meuhlenbeckia florulenta* and Hedge Saltbush *Rhagodia spinescens*. In the surrounding lunette dunes were found a number of interesting inland plants including Small Cooba *Acacia ligulata* and Willow Wattle *Acacia salicina* (Figure 32).



Figure 32. *Native vegetation cover at the northern extent of the project area near Lake Coorong (COR004)*

4 Management strategy

4.1 Condition summary

Overall, waterway condition across the Yarriambiack Creek catchment is very good. Summary observations include:

- A corridor of remnant riparian vegetation is present along the main waterway with good connectivity from the headwaters to the lower catchment
- Most waterways are either within cropped areas or are already fenced, however there are significant opportunities for improved stock management
- Weed control has been difficult and is a primary concern for landholders and community
- Only isolated areas of minor erosion were observed at road crossings and weirs
- There is strong community stewardship of waterway and catchment health

4.2 Opportunities

Four main opportunities for improved management were identified:

1. Addressing existing in-channel stock grazing where stock exclusion would encourage revegetation and provide continuous connection from the effluence to the lower catchment (biolinks) (Figure 33).
2. Addressing existing gaps in fencing along the waterway and riparian zone that can (when gaps are infilled) provide a continuous connection from the effluence to the lower catchment (Figure 34)
3. Supporting a major weed control program in the catchment, with a co-ordinated effort by landholders, the CMA and other stakeholder groups to fund and support the control and eradication of noxious weeds (Figure 35, Figure 36). Ideally the weed control program would progress from upstream (south) to downstream (north).
4. Undertaking stabilisation works to address minor erosion in localised areas, specifically at culverts and weir structures.

A combination of two or more of these four actions has also been considered for each reach.

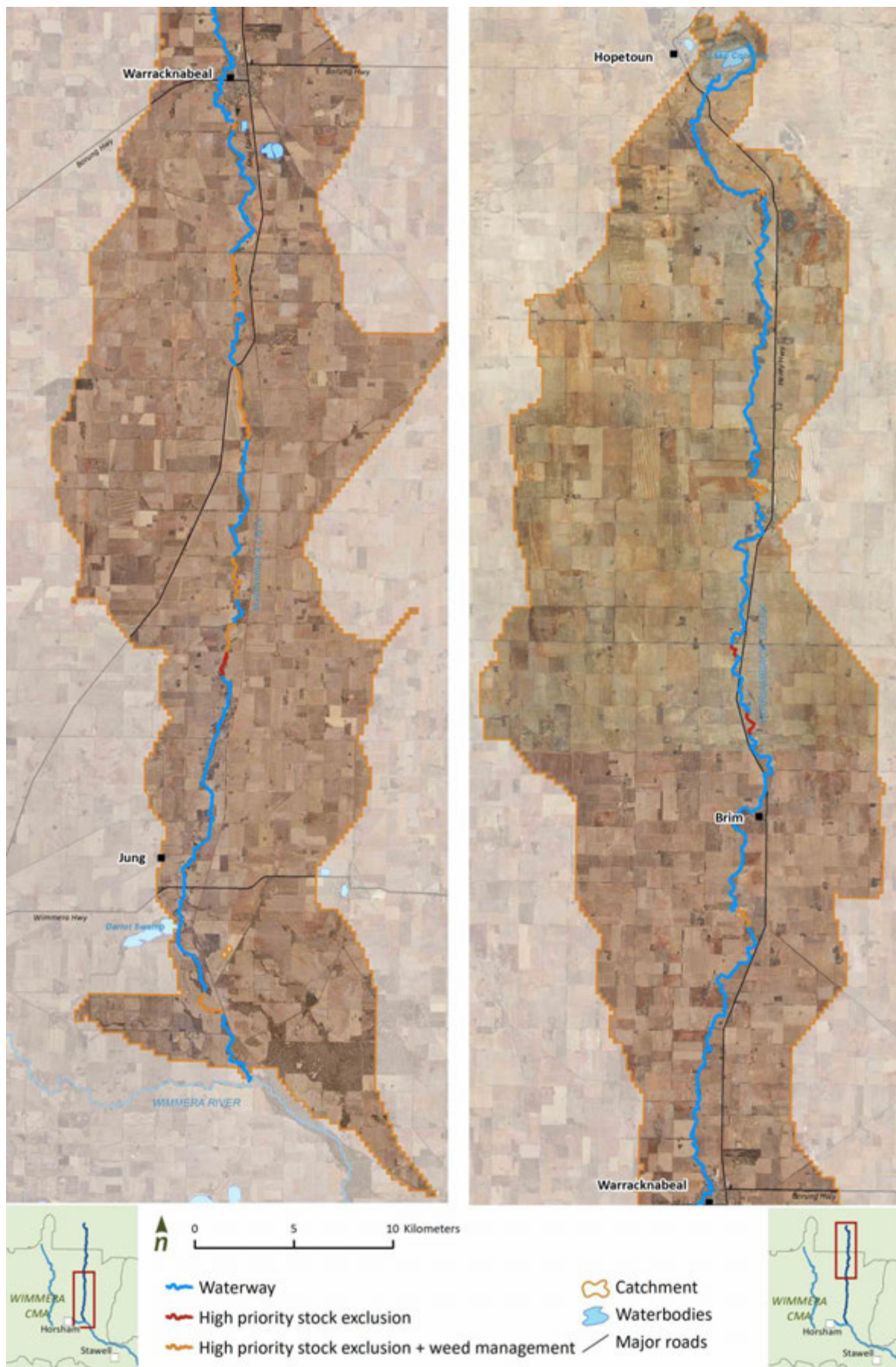


Figure 33. Stock exclusion priority zones

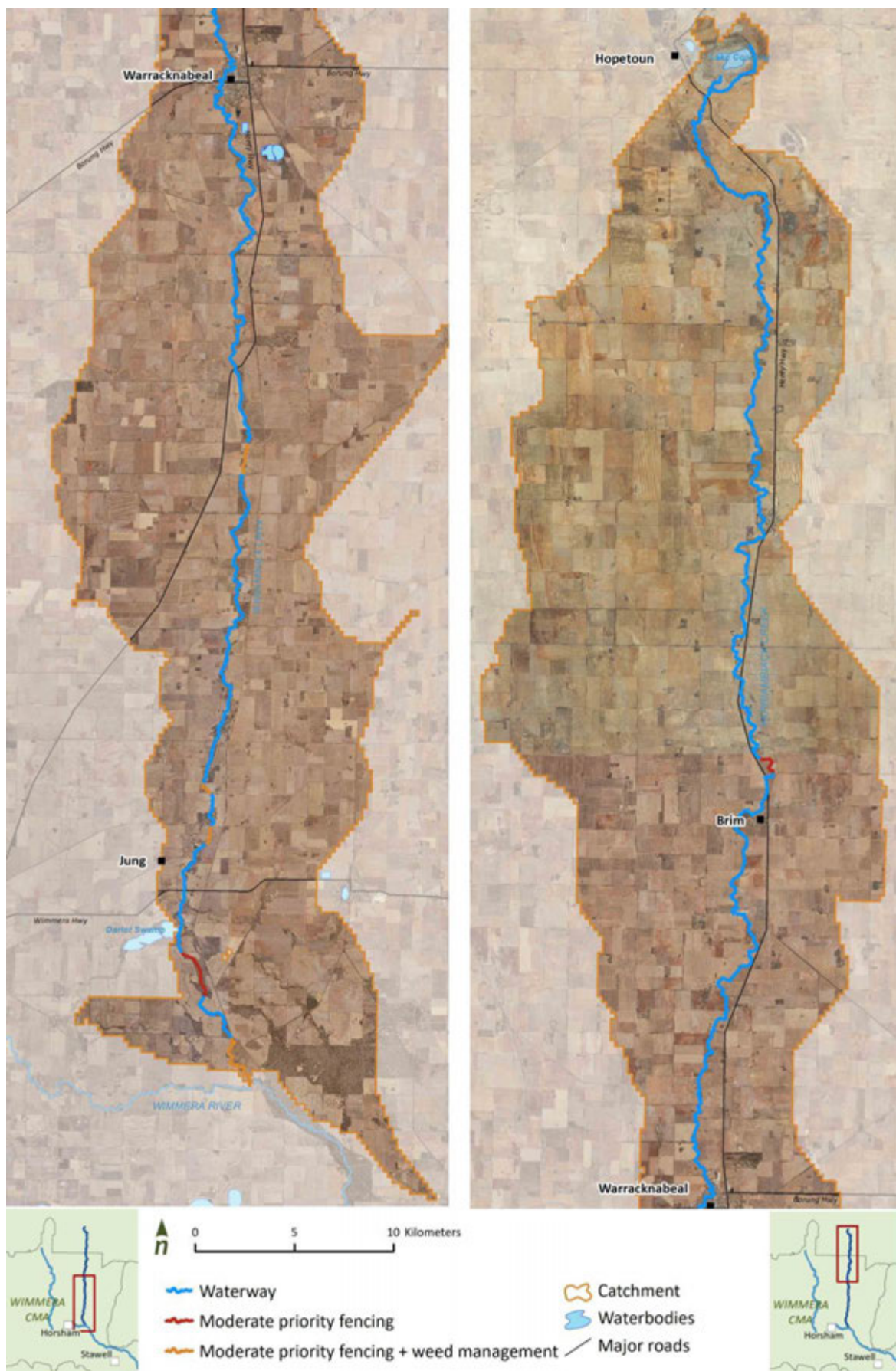


Figure 34. Priority zones for fencing (which includes stock exclusion). Note: there are no high priority fencing zones.

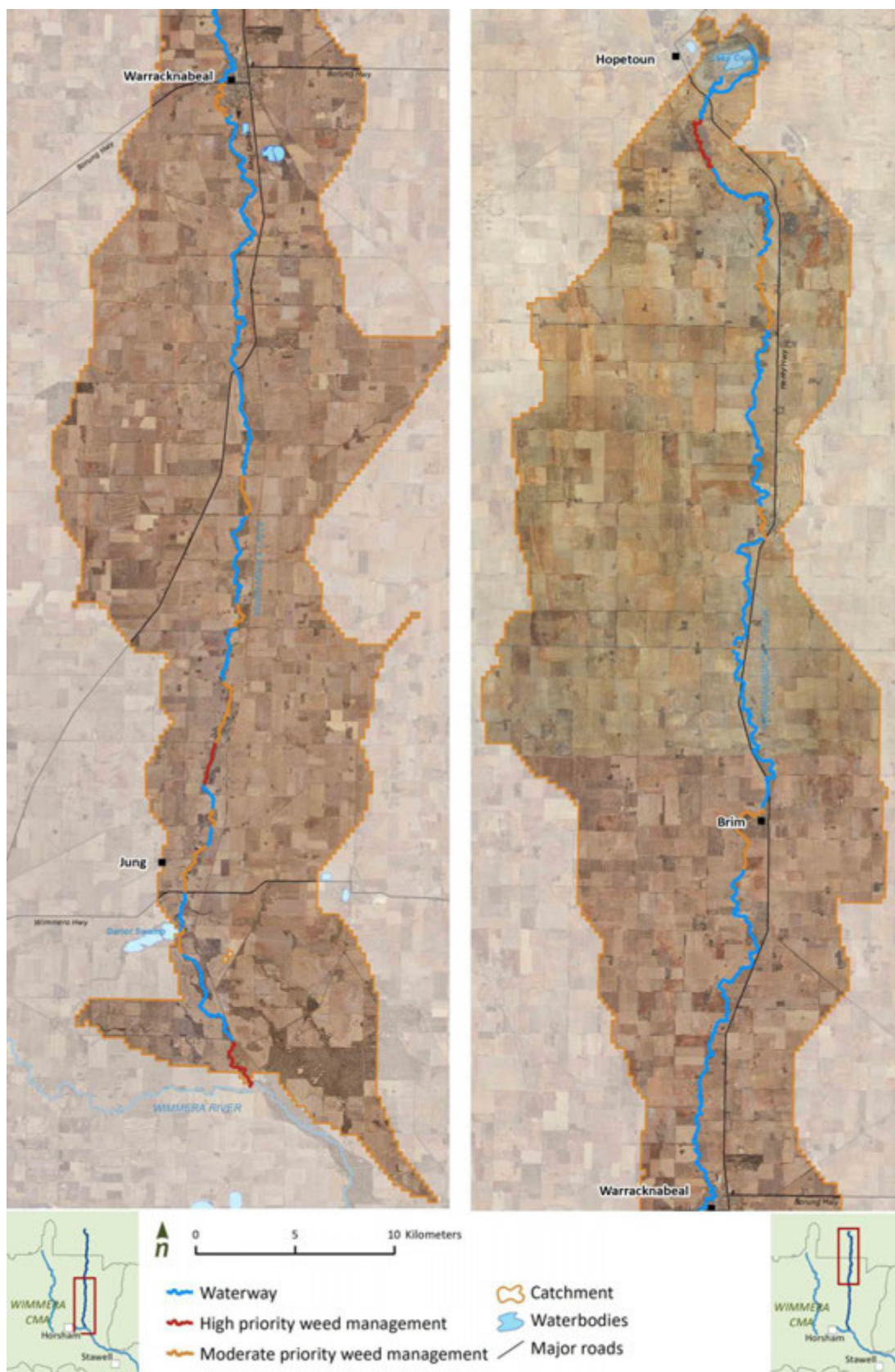


Figure 35. Priority areas for weed management

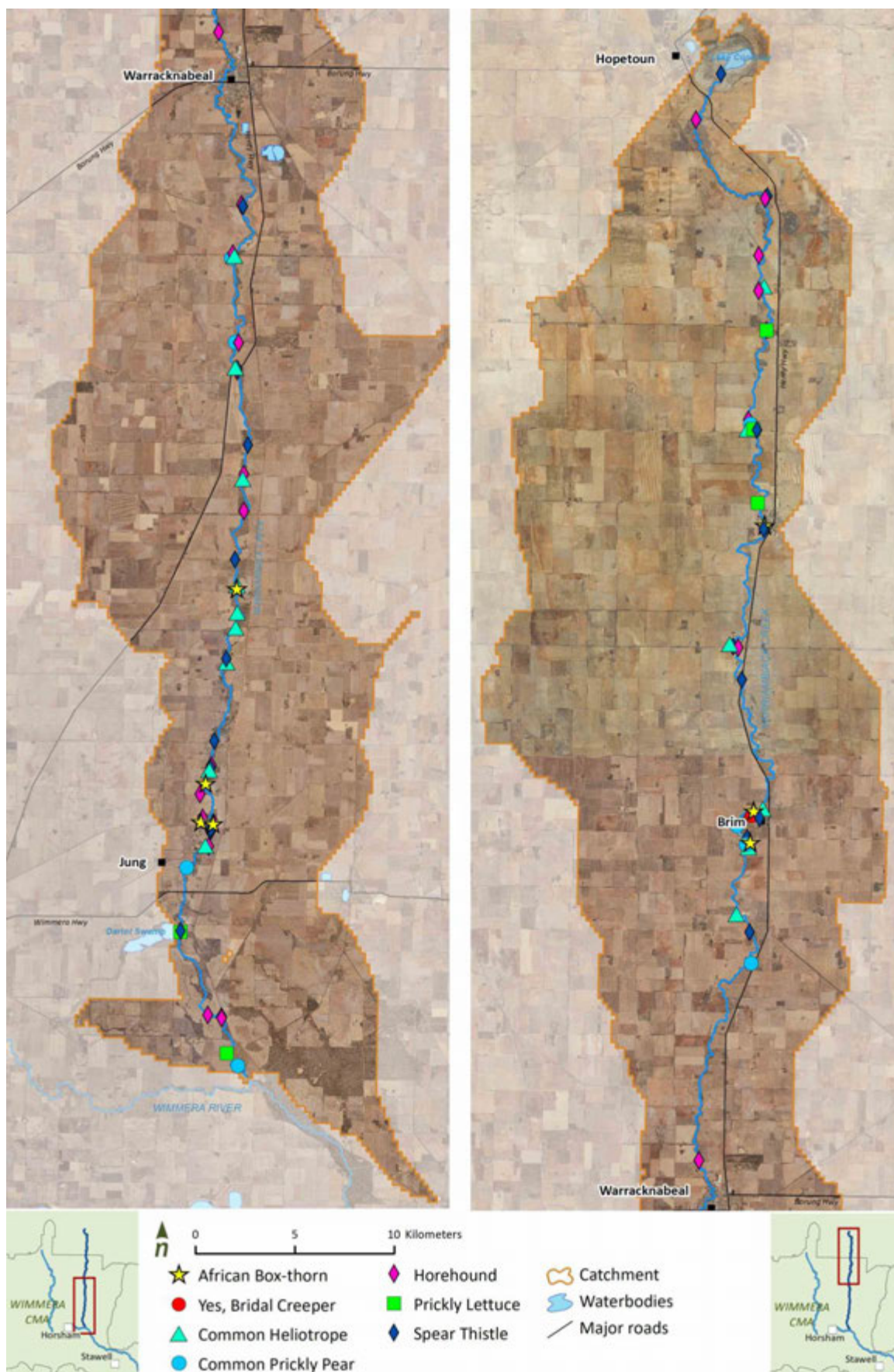


Figure 36. Indicative locations of substantial areas of invasive weeds along Yarriambiack Creek (determined through on-ground observations and stakeholder engagement)

4.3 Prioritised waterway actions

A prioritised program of waterway actions has been developed to inform the order of implementing on-ground works across the catchment (in other words, what should be done first, and where should it be done). The prioritisation process is based on the relative benefit of works at a particular location for achieving the overall management objectives for Yarriambiack Creek. The prioritisation process is one means of identifying the order that works should be implemented within a works program. Opportunistic works should be undertaken in parallel if particular locations have stronger landholder and community support for works.

Prioritisation process and management actions

The proposed objectives for management, and criteria for the benefit assessment are (in line with the WWS and WRCS):

1. Improvement in river health for the Yarriambiack Creek and Wimmera River waterways, including natural and cultural environmental values as highlighted in the Yarriambiack Creek Management Plan (YCAC, 2004).
2. Protection of remnant vegetation (including endangered Plains Woodland and Forests, Riverine Grassy Woodland EVCs)
3. Improving connectivity of vegetation corridors (biolinks)

The objectives are largely interlinked and are therefore equally weighted.

Management options

The prioritisation process was undertaken to rank the importance of management intervention (if required) for each waterway segment within the catchment. As discussed previously, the waterway condition for the catchment's segments were assessed via desktop review and field inspections. The observations have been recorded in a database supplied to the WCMA (and shown in Attachment B).

Where required, four management actions have been recommended for waterway rehabilitation:

- Weed management
- Stock exclusion
- Fencing and stock exclusion
- Earthworks / structural works

For each segment of waterway, the benefit of weed management was assessed (against the objectives), and then if any additional benefit was gained by adding stock exclusion, fencing and/or additional structural works.

In some segments of the catchment, management actions were not considered to provide a significant benefit over the existing conditions, and so those segments were given an "N/A" action, these included:

- Reaches that are currently effectively fenced and have significant remnant vegetation cover, existing revegetation works, and/or active vegetation recruitment
- Reaches that do not require a fence, weed management or vegetation works (i.e. the waterways within cropped land).

An ongoing monitoring and maintenance program to support the existing condition of these (and all) reaches is recommended.

Prioritisation process

Benefit was defined in this process by the improvement made relative to the objectives stated above. Each segment was given a score between one and five to indicate the relative benefit of investment at this location (Table 3). The higher the score the greater the benefit.

Table 3. Benefit scores and associated description

Benefit scores	Description of benefit
1	Very low
2	Low
3	Moderate
4	High
5	Very High

The priority ranking could then be calculated for each segment by multiplying the score achieved against each objective. Therefore, a score of 125 was the maximum score achievable, occurring where an option scores five against each of the three objectives.

The estimated associated *cost* for each action at each segment was determined, which allows for a rapid assessment of the benefit vs cost. Indicative costs for on-ground works (per metre) were supplied by the WCMA and estimated from previous works undertaken in the region (see Table 4). The prioritisation spreadsheet has been designed to allow the cost estimate to be varied as unit rates change in time.

Table 4. Estimated rate to implement on-ground waterway restoration works (supplied by the WCMA)

Management action	Indicative cost (\$/m)	Comment
Weed management	5	Indicative cost of managing weeds per metre
Fencing	12	Indicative cost is for fencing both sides of the waterway, therefore costs may be reduced if fencing is only required on one side.
Stock exclusion	1	Indicative cost of negotiation with landholders. Additional incentives may be required to be decided by WCMA
Grade control (\$ each)	Variable	Estimated on a site-by-site basis from similar works undertaken in Victoria. Cost approximations include both design and construction.

Table 5 shows an extract of the prioritisation spreadsheet (full table in Attachment C), highlighting six example segments for management actions. The prioritisation indicates that segment YAR072 has the top ranking, achieving the highest cost-benefit rating per metre of waterway for the catchment. This implies that stock exclusion for this segment would be highly effective in achieving the management objectives for minimal cost.

Segment YAR023, while achieving a slightly lower benefit, also requires weed management and is a much longer reach. The cost of implementing management actions is therefore higher, giving a lower cost-benefit rating overall. Similarly, section YAR030 requires weed management and fencing to achieve a comparable benefit, at additional cost, making it a lower priority.

Segments where weed management alone or structural works are required (e.g. YAR040 and YAR071) are generally a lower priority as these actions come at a higher cost, but do not provide significant benefits to waterway health. However, if safety and/or road stability become compromised and/or weed management is being undertaken immediately downstream of the segment, these actions may become a higher priority.

A number of segments (such as YAR097) appeared in good condition with little required action. These have been given an N/A priority, however ongoing monitoring of these sites is recommended. Figure 37 provides a catchment-wide overview of high, moderate and low priority reaches. The full prioritisation spreadsheet and detailed site maps of priority ranking and actions are available in Attachment C.

Table 5. Extract of prioritisation table

Yarriambiack Creek Waterway Action Plan - Prioritisation of Actions																																													
Segment	Stream length (m)	Weed management										Stock exclusion										Stock exclusion + Fence										Earthworks or structure													
		1 - Improvement in river health for the Yarriambiack Creek and Wimmera River waterways 2 - Protection of remnant vegetation (including endangered Plains Woodland and forests, Riverine Grassy Woodland EVCs) 3 - Improving connectivity of vegetation corridors (bio-links)										1 - Improvement in river health for the Yarriambiack Creek and Wimmera River waterways 2 - Protection of remnant vegetation (including endangered Plains Woodland and forests, Riverine Grassy Woodland EVCs) 3 - Improving connectivity of vegetation corridors (bio-links)										1 - Improvement in river health for the Yarriambiack Creek and Wimmera River waterways 2 - Protection of remnant vegetation (including endangered Plains Woodland and forests, Riverine Grassy Woodland EVCs) 3 - Improving connectivity of vegetation corridors (bio-links)										1 - Improvement in river health for the Yarriambiack Creek and Wimmera River waterways 2 - Protection of remnant vegetation (including endangered Plains Woodland and forests, Riverine Grassy Woodland EVCs) 3 - Improving connectivity of vegetation corridors (bio-links)													
		Benefit rating	Cost-benefit rating	Rate	Cost	Benefit	Weed Management required	Benefit rating	Cost-benefit rating	Rate	Cost	Benefit	Weed Management required	Benefit rating	Cost-benefit rating	Rate	Cost	Benefit	Weed Management required	Benefit rating	Cost-benefit rating	Rate	Cost	Benefit	Weed Management required	Benefit rating	Cost-benefit rating	Structure cost	Cost	Max cost - benefit rating	Cost	Priority	Recommended action(s)												
YAR072	598	0	0	0	0	0	5	5	5	-	2	3	3 N	18	18000	5	1	5	598	0	0	0 N	0	0	0	0	0	5	12	5	-	0	0	0 N	0	0	0	5	-	18000	5	598	High priority	Stock exclusion	
YAR023	2597	2	2	1	4	800	5	5	5	12,984	2	4	2 Y	16	2667	5	1	5	15,580	0	0	0 Y	0	0	0	0	0	5	12	5	-	0	0	0 Y	0	0	0	5	-	2667	5	15,580	High priority	Stock exclusion + Weed management	
YAR030	815	2	2	1	4	800	5	5	5	4,075	2	2	1 Y	4	667	5	1	5	4,890	3	3	2 Y	18	1059	5	12	5	13,855	0	0	0 Y	0	0	0	5	-	1059	5	13,855	Moderate priority	Stock exclusion + Fence + Weed management				
YAR040	3530	2	1	1	2	400	5	5	5	17,650	0	0	0 Y	0	0	0	5	1	5	-	0	0	0 Y	0	0	0	0	0	5	12	5	-	0	0	0 Y	0	0	0	5	-	400	5	17,650	Low priority	Weed management
YAR071	29	0	0	0	0	0	5	5	5	-	0	0	0 N	0	0	0	5	1	5	-	0	0	0 N	0	0	0	2	11	1 N	2	11	5,000	5,000	11	5	5,000	Low priority	Earthworks or structure *							
YAR097	1149	0	0	0	0	0	5	5	5	-	0	0	0 N	0	0	0	5	1	5	-	0	0	0 N	0	0	0	0	0	5	12	5	-	0	0	0 N	0	0	0	5	-	0	5	-	N/A	N/A

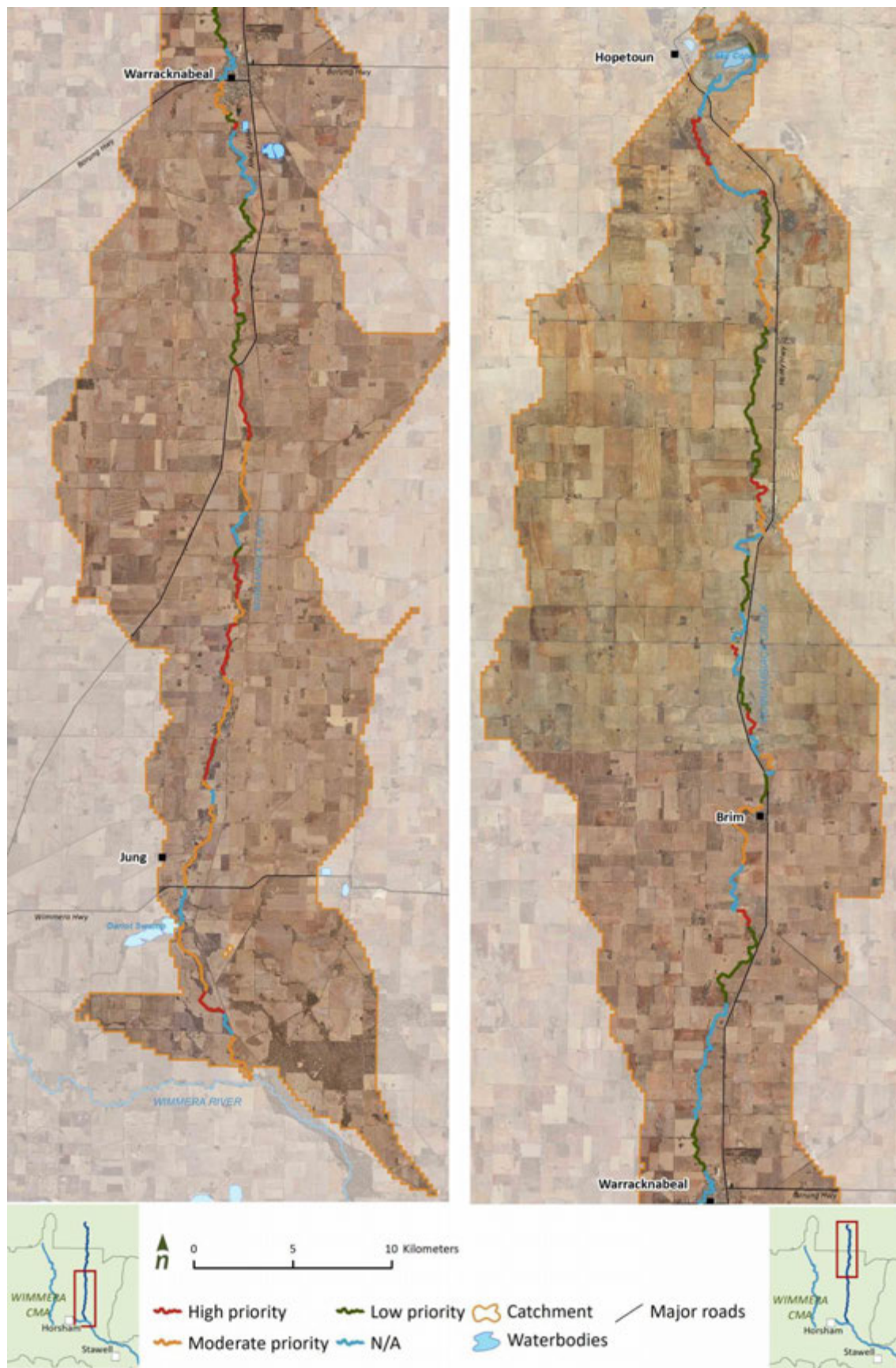


Figure 37. Catchment-wide prioritisation of actions based on prioritisation in Attachment C.

4.4 Implementation

There are a range of components considered to be important in the implementation of the Yarriambiack Creek WAP. It is recommended that these actions are undertaken as part of the WAP implementation process.

Review objectives and establish specific targets with stakeholder groups

The objectives defined in this WAP are based on the WWS, WRCS and Yarriambiack Creek Management Plan 2004. An important part of the implementation process will be to set agreed targets and metrics for monitoring the success of future works and investment. These may include targets like: a continuous connected riparian corridor from the effluence to Lake Coorong by 2030' (continuous fencing, set metrics to define measures of connectivity etc.), and 'the eradication of noxious weeds by 2050'. These targets and metrics should be aligned with the objectives set out in this WAP.

Establish a monitoring and evaluation program

The establishment of a monitoring and evaluation program is an important component of implementing the Yarriambiack Creek WAP. The monitoring and evaluation of changes to waterway condition will be important for assessing changes to the system and the success or failure of management works. A specific monitoring program should be developed that can be used to monitor condition across Yarriambiack Creek. The monitoring and evaluation program should provide sufficient detail to ensure that information on target metrics (as agreed with the stakeholder group) can be routinely assessed (minimum five-year intervals) and progress towards objectives can be tracked.

Review and modify incentive programs for holistic catchment management

Incentive programs are an important component of achieving long-term environmental outcomes. These programs may include incentives for landholders to manage stream frontages or sections of land for environmental purposes rather than agricultural or private purposes. Programs may include incentives associated with the retirement of marginalised land, fencing and revegetation of minor waterways, and changes to land management practices. Such programs should be reviewed and modified to ensure the most efficient strategy for long-term management Yarriambiack Creek is implemented.

4.5 Weed management priorities

The catchment contains a range of problem weeds, as summarised in Section 2.3. In general, it is recommended to target weed management activities upon species and locations where there is the greatest chance of success, or where intervention will prevent further spread.

Priority weed management activities include:

- Undertaking weed management at sites where other investment or effort has been applied, including revegetation sites, or in high quality remnant vegetation.
- Treatment of woody weeds throughout the catchment, particularly the middle and upper catchment:
 - Woody weed removal can be highly effective and can lead to eradication of some problem species provided monitoring and follow up weed control is applied.
 - Woody weed species to target include introduced species such as Sweet Briar *Rosa rubiginosa* and African Box-thorn *Lycium ferocissimum*.
- Control of relatively new weeds with high invasive potential. Key species identified in the public consultation and field investigation include Common Prickly Pear *Opuntia stricta* and Wheel Cactus *O. robusta*. Control of these plants is labor intensive, involving methods such as manual removal, herbicide wiping or spot spraying. Follow-up monitoring and repeated control will be required to eradicate these species from infested areas. These species are most problematic in the upper and middle catchment. Priority should be given to removing these species from revegetation sites or high quality native vegetation, and it is also worth prioritising removal from sites where they are not fully established.

- Control of Heliotrope *Heliotropium europaeum* within road reserves close to source populations in townships.

Where possible, weed management activities should be coordinated to include multiple landholders (including public land managers), to minimise the spread of weeds back into treated areas from untreated neighbouring land.

4.6 Revegetation

Vegetation condition across the Yarriambiack is in good condition and revegetation is therefore not deemed a priority action. While revegetation works were not included in action prioritisation, one reach (YAR035, Figure 38) was identified as benefitting from localised revegetation works. In this reach, there was little evidence of stock access and weeds, however overstorey and midstorey vegetation was lacking.

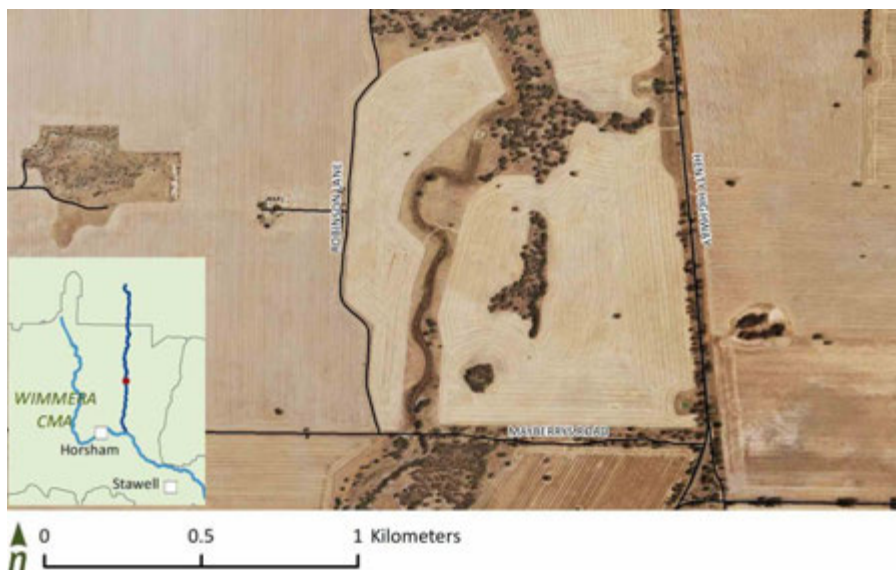


Figure 38. Site YAR035 (downstream of Mayberrys Road) where revegetation works would be recommended

Revegetation should be carried out with locally indigenous species where possible. Advice should be sought from the local Landcare group or WCMA for planting recommendations, and it is recommended to inspect nearby bushland reserves to assist in species selection if possible. It is recommended to plant and establish the tree and shrub layers before planting understorey species, as it is easier to manage competition with introduced understorey species (such as perennial pasture grasses) for tree and shrub plantings.

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Attachment A

Vegetation species list

Species name	Common name	Weed	Comments
<i>Acacia acinacea</i>	Gold dust Wattle	No	
<i>Acacia brachybotrya</i>	Grey Wattle	No	
<i>Acacia ligulata</i>	Sandhill Wattle	No	
<i>Acacia montana</i>	Mallee Wattle	No	
<i>Acacia oswaldii</i>	Umbrella Mulga	No	Regionally Rare
<i>Acacia paradoxa</i>	Kangaroo Thorn	No	
<i>Acacia salicina</i>	Willow wattle	No	Regionally Rare
<i>Acacia saligna</i>	Coojong	Yes	Native weed
<i>Allocasuarina luehmannii</i>	Buloke	No	
<i>Aloe sp</i>	Aloe	Yes	
<i>Alternanthera denticulata</i>	Lesser joyweed	No	
<i>Artemisia arborescens</i>	Wormwood	Yes	
<i>Asparagus asparagoides</i>	Bridal Creeper	Yes	Weed of National Significance, noxious weed restricted in Victoria
<i>Asparagus officinalis</i>	Wild asparagus	Yes	
<i>Atriplex leptocarpa</i>	Creeping Saltbush	No	
<i>Atriplex sp</i>	Saltbush	No	
<i>Austrostipa spp</i>	Speargrass	No	
<i>Avena fatua</i>	Wild Oats	Yes	
<i>Bursaria spinosa</i>	Sweet Busaria	No	
<i>Callistemon brachyandrus</i>	Prickly bottlebrush	No	First record for region
<i>Callitris gracilis</i>	Southern Cypress Pine	No	
<i>Carpobrotus aequilaterus</i>	Angled Pigface	Yes	
<i>Centipeda cunninghamii</i>	Old man weed or Sneezeweed	No	
<i>Chrysanthemoides monilifera</i>	Boneseed	Yes	Weed of National Significance, noxious weed, controlled in Wimmera and Mallee
<i>Cirsium vulgare</i>	Spear Thistle	Yes	Noxious weed restricted in Wimmera and Mallee
<i>Citrullus lanatus</i>	Camel Melon	Yes	
<i>Dianella admixta</i>	Spreading-flax lily	No	
<i>Dianella sp nov aff longifolia</i>	Riverina	No	Listed as vulnerable in Victoria (DELWP)
<i>Dittrichia graveolens</i>	Stinkweed	Yes	Noxious weed restricted in Wimmera and Mallee
<i>Ehrharta calycina</i>	Perennial Veldt Grass	Yes	
<i>Eleocharis sphacelata</i>	Tall Spike-rush	No	
<i>Eragrostis infecunda</i>	Southern Cane-Grass	No	Regionally Rare
<i>Eremophila longifolia</i>	Berregan or long-leaved emu bush	No	
<i>Eremophila maculata</i>	Spotted Emu Bush	No	
<i>Eryngium ovinum</i>	Sea Holly	No	
<i>Euphorbia sp</i>	Poinsettia	No	
<i>Eutaxia microphylla var diffusa</i>	Common Eutaxia	No	
<i>Fraxinus angustifolia</i>	Desert Ash	Yes	

<i>Glycyrrhiza acanthocarpa</i>	Native Licorice	No	
<i>Hakea tephrosperma</i>	Hooked Needlewood	No	
<i>Heliotropium europaeum</i>	Common Heliotrope	Yes	
<i>Helminthotheca echioides</i>	Bristly Ox-tongue Daisy	Yes	
<i>Lachnagrostis filiformis var perennis</i>	Wetland blown-Grass	No	
<i>Lactuca serriola</i>	Prickly Lettuce	Yes	
<i>Lomandra effusa</i>	Scented mat-rush	No	
<i>Lycium ferrosissimum</i>	African Box-thorn	Yes	Weed of National Significance, noxious weed controlled in Wimmera and Mallee
<i>Maireana brevifolia</i>	Cotton Bush	No	
<i>Maireana sp</i>	Bluebush	No	
<i>Marrubium vulgare</i>	Horehound	Yes	Noxious weed controlled in Wimmera and Mallee
<i>Marselia drummondii</i>	Common Nardoo	No	
<i>Meuhlenbeckia florulenta</i>	Lignum	No	
<i>Myoporum insulare</i>	Native Juniper	No	
<i>Myoporum parvifolium</i>	Creeping Boobialla	No	
<i>Myoporum platycarpum</i>	Sugarwood	No	
<i>Myriophyllum sp</i>	Guyana	No	
<i>Nicotiana glauca</i>	Wild Tobacco	Yes	
<i>Olea europaea</i>	Wild Olive Tree	Yes	
<i>Opuntia robusta</i>	Wheel Cactus	Yes	Weed of National Significance, noxious weed controlled in Wimmera and Mallee
<i>Opuntia stricta</i>	Common Prickly Pear	Yes	Weed of National Significance, noxious weed controlled in Wimmera and Mallee
<i>Paspalum dilatatum</i>	Paspalum grass	Yes	
<i>Phalaris aquatic</i>	Phalaris	Yes	
<i>Phoenix canariensis</i>	Canary Island Date Palm	Yes	
<i>Pittosporum angustifolium</i>	Butterbush	No	
<i>Potamogeton sp</i>	Pondweed	No	
<i>Pterostylis cheraphila</i>	Floodplain rustyhood	No	
<i>Ptilotus exaltatus</i>	Mulla Mulla	No	
<i>Reseda luteola</i>	Weld or Wild Mignonette	Yes	Noxious weed restricted in Victoria
<i>Rhagodia spinescens</i>	Spiny Saltbush	No	
<i>Rosa rubiginosa</i>	Sweet Briar	Yes	Noxious weed controlled in Wimmera, restricted in Mallee
<i>Rumex crispus</i>	Curled Dock	Yes	
<i>Rytidosperma spp</i>	Wallaby Grass	No	
<i>Salsola Tragus</i>	Prickly Russian Thistle	No	
<i>Salvia verbenaca</i>	Wild Sage	Yes	
<i>Schinus molle</i>	Peppercorn	Yes	
<i>Sclerolaena muricata</i>	Perennial Shrub	No	
<i>Senna artemisioides</i>	Silver Cassia	No	
<i>Sida corrugata</i>	Corrugated Sida	No	
<i>Solanum esuriale</i>	Potato Weed/Quena	No	

<i>Solanum nigrum</i>	Black Nightshade	Yes	
<i>Triglochin alcockiae</i>	Southern Water Ribbons	No	
<i>Triglochin procera</i>	Water Ribbons	No	
<i>Typha domingensis</i>	Narrow-leaf Cumbungi	No	
<i>Ulmus sp</i>	Black Elm	Yes	
<i>Vallisnaria spiralis</i>	Tapegrass	Yes	
<i>Xanthium spinosum</i>	Bathurst Burr	Yes	Noxious weed controlled in Wimmera and Mallee

Attachment B

Waterway condition data

Site ID	Site name	Length (m)	Weeds	Stock	Fencing	Erosion	Comments
COR001	Lake Coorong	1011	N	Nil	N/A	N	Cropped, no fence
COR002	Lake Coorong	1742	N	Nil	Effective	N	Cropped and fenced, sand dunes
COR003	Lake Coorong	696	Y	Nil	Effective	N	Rabbits, prickly lettuce
COR004	Lake Coorong	768	N	Nil	Effective	N	Recent rabbit management, black wallaby sighted
DAR001	Darlot Swamp	159	Y	Nil	N/A	N	Cane grasses in swamp
YAR001	Effluence to Longerenong Road	3590	Y	Neighbouring	Ineffective	N	Stock in neighbouring paddocks, no fence
YAR002	North of Longerenong Road	1314	N	Nil	Ineffective	N	Not fenced, open to road
YAR003	West of Corkers Creek Road	2150	Y	In corridor	Effective	N	Stocking within channel corridor has reduced weeds
YAR004	South of Webbs Dry Weather Road	2686	Y	Neighbouring	Ineffective	N	Unsure if fully fenced, stocked in neighbouring paddock
YAR005	Webbs Dry Weather Road to Darlot Swamp offtake	1415	Y	Nil	N/A	N	
YAR006	Yarriambiack North of Darlot Swamp channel	913	N	Neighbouring	Effective	N	Grazed on left bank, but adequately fenced
YAR007	South of Wimmera Highway	991	N	Nil	Effective	N	No signs of stock, still fenced
YAR008	Wimmera Highway to railway, including Jung Tip	2025	Y	Nil	Effective	N	No signs of stock, still fenced. Jung tip loosely rehabilitated, lots of weeds
YAR009	Jung Recreation Reserve	586	Y	Nil	N/A	N	
YAR010	Jung Weir pool	423	Y	Neighbouring	Ineffective	N	Stock right bank, no fence
YAR011	Jung Weir	48	Y	Neighbouring	Ineffective	Y	Scour on left bank of low flow channel, remove trees on chute
YAR012	Jung Weir to Greenhills Road	946	Y	In corridor	Ineffective	N	Wide fence on right bank
YAR013	Greenhills Road	50	Y	Nil	N/A	N	
YAR014	North of Greenhills Road	1072	Y	Neighbouring	Effective	N	Lightly grazed on right side, but fenced, good riparian corridor
YAR015	South of Schaches/Bells Road	780	N	Nil	N/A	N	Cropping both sides
YAR016	North of Schaches/Bells Road	719	Y	Neighbouring	Ineffective	N	Light stocking on left bank
YAR017	South of Banyena Road	2199	Y	Nil	Effective	N	Fenced both sides, not stocked
YAR018	Banyena-Pimpinio Road to Mokepilly Road	3729	Y	Neighbouring	Effective	N	Only very light stocking if any at DS extent, right bank. Golf Course right bank
YAR019	Mokepilly Road to Drillers Road	1440	Y	In corridor	Effective	N	Grazed in corridor, but fenced
YAR020	Drillers Road to Horsham-Minyip Road	1784	Y	In corridor	Effective	N	Grazed in corridor, but fenced
YAR021	Horsham-Minyip Road	70	Y	Nil	N/A	N	
YAR022	North of Horsham-Minyip Road	1563	Y	Nil	Effective	N	Fenced, wide riparian corridor/woodland
YAR023	South of Daveys Road	2597	Y	In corridor	Effective	N	Stocked in corridor, but fence present
YAR024	North of Daveys Road	686	Y	Nil	Effective	N	Low-no stocking upstream of road
YAR025	South of Minyip-Dimboola Road	2233	N	Neighbouring	Effective	N	Stocking in neighbouring right bank land, appears to be an effective fence
YAR026	North of Minyip-Dimboola Road	1111	Y	Nil	Ineffective	N	Old fence, but no stock
YAR027	South of Yarriambiack Drive	1140	Y	Nil	Effective	N	Fenced, no stock
YAR028	Yarriambiack Drive	82	Y	Nil	N/A	N	Horehound, heliotrope
YAR029	North of Yarriambiack Drive	838	Y	Neighbouring	Ineffective	N	Lightly stocked, no fence right side. Fox sighting.
YAR030	South of Roses Road	815	Y	Neighbouring	Ineffective	N	Cane grass, no fence on right side. Fenced left side
YAR031	Roses Road	60	Y	Nil	N/A	N	Roses Road crossing, no scour evident
YAR032	Roses Road to Henty Hwy	4127	Y	In corridor	Effective	N	Wide corridor, from aerial imagery appears to be stocked inside corridor
YAR033	Henty Hwy at Kellalac	64	Y	Nil	N/A	N	Kellalac Streamside and Recreation Reserve
YAR034	Henty Hwy to Mayberrys Road	1651	Y	Nil	Effective	N	No stocking apparent in corridor, fencing both sides
YAR035	North of Mayberrys Road	1920	Y	Nil	N/A	N	Cropped, no fence, no stock, sparse vegetation
YAR036	South of Moloneys Road	653	Y	In corridor	Effective	N	Possible light grazing within corridor
YAR037	Moloneys Road	63	Y	Nil	N/A	N	Rabbits prolific
YAR038	Moloneys Road to Ailsa Road	2750	Y	In corridor	Ineffective	N	Only Right bank fenced, stocking in channel with left side fenced over road
YAR039	Ailsa Road	140	Y	Nil	N/A	Y	Scour hole, tunneling in road
YAR040	Ailsa Road to Boundary Road	3530	Y	Nil	Effective	N	Reserve is fully fenced, no evidence of stock
YAR041	Boundary Road	353	Y	Nil	N/A	Y	Very minor scour at culvert
YAR042	Boundary Road to Dumbuoy Road	4840	Y	Nil	Effective	N	Old stock access noted at Bell Road, fully fenced, doesn't appear to be currently stocked



YAR043	North of Dumbuoy Road along Peppercorn Road	469	Y	In corridor	Effective	N	Sheep grazing in corridor, big rubbish tip on right bank - source of weeds
YAR044	South of Dumbuoy Road and cemetery	890	Y	Nil	Effective	N	Possibly exotics from neighbouring house
YAR045	Dumbuoy Road to Dimboola Road	2929	Y	Nil	N/A	N	Weeds, rabbits, gambusia reported
YAR046	Dimboola Road	50	Y	Nil	N/A	N	No scour evident at stormwater outlet
YAR047	Dimboola Road to Phillips Street	1179	Y	Nil	N/A	N	No scour evident at Jamouneau St/Phillips Street
YAR048	Phillips Street to Rainbow Road	1487	Y	Nil	N/A	N	No scour evident at previous hotspots
YAR049	Rainbow Road to Morella Road West	3439	Y	Nil	Effective	N	
YAR050	Morella Road West	514	N	Nil	Effective	N	No sign of piping near Morella Road W
YAR051	Morella Road W to Bangerang Road W	2085	N	Nil	Effective	N	
YAR052	Bangerang Road W to Batchica Lane	1266	Y	Neighbouring	Effective	N	Rabbits present
YAR053	Batchica Lane to Darts/Batchica West Road	1155	N	Nil	Ineffective	N	Very wide corridor, nest boxes near Batchica Lane
YAR054	Darts/Batchica West Road to Neumann Lane	2799	N	Nil	N/A	N	Aerials show cropped land
YAR055	Neumann Lane to Exchange Road	909	Y	Nil	N/A	N	Pine, horehound
YAR056	North of Exchange Road	833	Y	Nil	N/A	N	Works on wood bridge complete
YAR057	Neumann Lane	1168	Y	Nil	Effective	N	Fenced, cropped land
YAR058	South of Lah Tip	1149	Y	Nil	Effective	N	Flax lily and Sweet Bursaria
YAR059	Lah Tip	993	Y	Nil	Effective	N	Weeds from Lah Tip
YAR060	South of Lah West Road	848	Y	Nil	Ineffective	N	Not fully fenced, but no stock in reserve. Rabbits. Motorcycle tracks
YAR061	North of Lah West Rod	1372	Y	In corridor	Effective	N	Rabbits and fox traps, grazing in creek.
YAR062	North East of Lah	3331	Y	Nil	Effective	N	Better condition than downstream, no evidence of stock, weeds reported.
YAR063	South of Brim weir pool	1885	Y	Neighbouring	Effective	N	Stock in paddock, but fenced. Weeds surrounding old house site, old dams
YAR064	Brim Weir pool	1160	Y	Nil	Effective	N	Dead carp US of weir pool, some dumped lawn clippings could be source of weeds
YAR065	Brim West Road to Wurfel Road	924	Y	Nil	N/A	N	Unable to find evidence of erosion at previously identified hotspot, heritage tree
YAR066	Wurfel Road to Golf Course Lane	630	Y	Neighbouring	Effective	N	Golf course right bank, stock left bank
YAR067	Golf Course Lane to Henty Hwy nr Wardles Road W	1603	N	Neighbouring	Effective	N	Stock in areas, but effectively fenced
YAR068	Along Wardles Road East	553	N	Nil	Ineffective	N	Not fenced, but road reserve with no stock. Bulokes present
YAR069	North of Wardles Road East	1435	N	Neighbouring	Ineffective	N	Potentially stocked (not recent), new fence required left bank
YAR070	Along Henty Hwy, south of Baums Road	1596	N	Nil	Ineffective	N	Only fenced right side, but no apparent stocking
YAR071	Baums Road	29	N	Nil	N/A	Y	Minor erosion at headwall
YAR072	North of Baums Road	598	N	In corridor	Effective	N	Stock in channel, rabbits apparent on aerial
YAR073	South of Sturrocks Road	811	Y	In corridor	Effective	N	Very wide corridor, evidence of stock access
YAR074	South of Henty Hwy, near Sturrocks Road	2328	Y	Nil	N/A	N	Doesn't appear to be stocked
YAR075	Henty Hwy crossing nr Ryans Road	62	Y	Nil	N/A	N	Some weeds, but has been managed
YAR076	North of Henty Hwy crossing nr Ryans Road	1405	N	Nil	Effective	N	Doesn't appear to be stocked
YAR077	South of Galaquil West Road	788	N	In corridor	Ineffective	N	Neighbouring land and corridor both stocked, fenced but gates open and stock running freely
YAR078	Galaquil West Road	185	Y	Nil	N/A	Y	Rabbits, tunneling in road, culvert scour D/S, headwall sinking/tilting
YAR079	North of Galaquil West Road	797	Y	Nil	Effective	N	
YAR080	West of Henty Hwy nr Galaquil West Road	1339	N	Nil	N/A	N	Cropped both sides
YAR081	South of Brentwood West Road	3280	Y	Neighbouring	Effective	N	Cropped left side, stocked right side, but adequately fenced. Weeds around house site
YAR082	North of Brentwood West Road	1516	N	Neighbouring	Effective	N	Possibly neighbouring stock right side, but fenced, cropping left side
YAR083	South of Beulah, near Henty Hwy	943	N	Nil	Effective	N	No evidence of stock, fence both sides
YAR084	Henty Hwy nr Beulah to Birchip-Rainbow Road	2054	Y	Nil	N/A	N	Very noxious weeds present, weir pool
YAR085	North of Birchip-Rainbow Road	2144	Y	In corridor	Effective	N	Horses grazing in channel - not heavily grazed
YAR086	South of Golf Hill Road	3365	Y	Nil	N/A	N	Cropping both sides, no evidence of stocking
YAR087	Golf Hill Road to Rosebery-Rainbow Road	6454	Y	Nil	Effective	N	Cropping both sides, fenced, but lots of weeds and dumping of rubbish DS of Golf Hill Road
YAR088	Rosebery-Rainbow Road	69	Y	Nil	N/A	Y	Scour at culvert inlet, rabbit warrens, barn owl sighted
YAR089	Rosebery-Rainbow Road to Windy Ridge Road	2650	Y	Nil	Effective	N	Cropping both sides, fenced. Weeds, foxes, rabbits and rubbish dumped, some fire dieback
YAR090	Windy Ridge Road to Roseberry North West Road	2088	Y	Nil	Effective	N	Cropping both sides, rabbits, weeds and rubbish
YAR091	Rosebery North West Road to Goyura West Road	3845	Y	Nil	N/A	N	Wide corridor, no stocking, rabbits and weeds at road, Black wallaby sighted



YAR092	North of Goyura West Road	550	Y	In corridor	Effective	N	Stocking in corridor, rabbit warrens, weeds, boxthorn management
YAR093	Along Angle Road to East of Clancy Road	3346	N	Nil	N/A	N	Cropping both sides
YAR094	South of Robins Lane	3476	Y	Nil	N/A	N	No stocking and fenced at road
YAR095	Robins Lane to Henty Hwy	1270	N	Nil	Effective	N	Cropped both sides and fenced. Hooded Robin Sighted
YAR096	Henty Hwy near Lake Coorong	466	N	Nil	N/A	N	No fence, but cropped, native grass patches, black wallaby sighted
YAR097	Yarriambiack Creek flowing into Lake Coorong	1149	N	Nil	N/A	N	Not stocked, increasing salinity, some regeneration after flood, very sparse canopy, black cracking soils



Attachment C

Prioritised actions

Yarriambiack Creek Waterway Action Plan - Prioritisation of Actions																																																	
Segment	Stream length (m)	Weed management										Stock exclusion										Stock exclusion + Fence - Prioritisation of Actions										Earthworks or structure																	
		1 - Improvement in river health for the Yarriambiack Creek and Wimmera River waterways					2 - Protection of remnant vegetation (including endangered Plains Woodland and Forests, Riverine Grassy Woodland EVCs)					3 - Improving connectivity of vegetation corridors (bio-links)					All	1 - Improvement in river health for the Yarriambiack Creek and Wimmera River waterways					2 - Protection of remnant vegetation (including endangered Plains Woodland and Forests, Riverine Grassy Woodland EVCs)					3 - Improving connectivity of vegetation corridors (bio-links)					All	1 - Improvement in river health for the Yarriambiack Creek and Wimmera River waterways					2 - Protection of remnant vegetation (including endangered Plains Woodland and Forests, Riverine Grassy Woodland EVCs)					3 - Improving connectivity of vegetation corridors (bio-links)					All
		Benefit	Benefit rating	Cost-benefit rating	Rate	Cost	Benefit	Weed Management required	Benefit rating	Cost-benefit rating	Rate	Cost	Benefit	Weed Management required	Benefit rating	Cost-benefit rating	Rate	Cost	Benefit	Weed Management required	Benefit rating	Cost-benefit rating	Rate	Cost	Benefit	Weed Management required	Benefit rating	Cost-benefit rating	Structure cost	Cost	Max cost - benefit rating	Cost	Priority	Recommended action(s)															
YAR072	598	0	0	0	0	\$ -	2	3	3	N	18	18000	\$ 1	\$ 598	0	0	0	N	0	0	0	N	0	0	\$ 12	\$ -	0	0	0	N	0	0	\$ -	\$ -	18000	\$ 598	High priority	Stock exclusion											
YAR073	811	0	0	0	0	\$ -	2	3	3	N	18	18000	\$ 1	\$ 811	0	0	0	N	0	0	0	N	0	0	\$ 12	\$ -	0	0	0	N	0	0	\$ -	\$ -	18000	\$ 811	High priority	Stock exclusion											
YAR019	1440	0	0	0	0	\$ -	2	4	2	N	16	16000	\$ 1	\$ 1,440	0	0	0	N	0	0	0	N	0	0	\$ 12	\$ -	0	0	0	N	0	0	\$ -	\$ -	16000	\$ 1,440	High priority	Stock exclusion											
YAR077	788	0	0	0	0	\$ -	2	2	3	N	12	12000	\$ 1	\$ 788	3	3	2	N	18	1500	\$ 12	\$ 9,456	0	0	0	N	0	0	0	N	0	0	\$ -	\$ -	12000	\$ 788	High priority	Stock exclusion											
YAR061	1372	1	2	1	2	400	\$ 5	\$ 6,858	2	3	4	Y	24	4000	\$ 1	\$ 8,229	0	0	0	Y	0	0	\$ 12	\$ -	0	0	0	Y	0	0	0	Y	0	0	\$ -	\$ -	4000	\$ 8,229	High priority	Stock exclusion + Weed management									
YAR092	550	1	2	1	2	400	\$ 5	\$ 2,751	2	3	4	Y	24	4000	\$ 1	\$ 3,302	0	0	0	Y	0	0	\$ 12	\$ -	0	0	0	Y	0	0	0	Y	0	0	\$ -	\$ -	4000	\$ 3,302	High priority	Stock exclusion + Weed management									
YAR003	2150	3	2	1	6	1200	\$ 5	\$ 10,752	3	3	2	Y	18	3000	\$ 1	\$ 12,902	0	0	0	Y	0	0	\$ 12	\$ -	0	0	0	Y	0	0	0	Y	0	0	\$ -	\$ -	3000	\$ 12,902	High priority	Stock exclusion + Weed management									
YAR020	1784	2	2	1	4	800	\$ 5	\$ 8,918	3	3	2	Y	18	3000	\$ 1	\$ 10,702	0	0	0	Y	0	0	\$ 12	\$ -	0	0	0	Y	0	0	0	Y	0	0	\$ -	\$ -	3000	\$ 10,702	High priority	Stock exclusion + Weed management									
YAR043	469	2	1	1	2	400	\$ 5	\$ 2,343	3	2	3	Y	18	3000	\$ 1	\$ 2,812	0	0	0	Y	0	0	\$ 12	\$ -	0	0	0	Y	0	0	0	Y	0	0	\$ -	\$ -	3000	\$ 2,812	High priority	Stock exclusion + Weed management									
YAR032	4127	2	1	1	2	400	\$ 5	\$ 20,633	2	4	2	Y	16	2667	\$ 1	\$ 24,760	0	0	0	Y	0	0	\$ 12	\$ -	0	0	0	Y	0	0	0	Y	0	0	\$ -	\$ -	2667	\$ 24,760	High priority	Stock exclusion + Weed management									
YAR038	2750	2	1	1	2	400	\$ 5	\$ 13,752	2	4	2	Y	16	2667	\$ 1	\$ 16,502	0	0	0	Y	0	0	\$ 12	\$ -	0	0	0	Y	0	0	0	Y	0	0	\$ -	\$ -	2667	\$ 16,502	High priority	Stock exclusion + Weed management									
YAR023	2597	2	2	1	4	800	\$ 5	\$ 12,984	2	4	2	Y	16	2667	\$ 1	\$ 15,580	0	0	0	Y	0	0	\$ 12	\$ -	0	0	0	Y	0	0	0	Y	0	0	\$ -	\$ -	2667	\$ 15,580	High priority	Stock exclusion + Weed management									
YAR036	653	2	1	1	2	400	\$ 5	\$ 3,267	2	4	2	Y	16	2667	\$ 1	\$ 3,921	0	0	0	Y	0	0	\$ 12	\$ -	0	0	0	Y	0	0	0	Y	0	0	\$ -	\$ -	2667	\$ 3,921	High priority	Stock exclusion + Weed management									
YAR085	2144	1	2	3	6	1200	\$ 5	\$ 10,720	1	4	4	Y	16	2667	\$ 1	\$ 12,864	0	0	0	Y	0	0	\$ 12	\$ -	0	0	0	Y	0	0	0	Y	0	0	\$ -	\$ -	2667	\$ 12,864	High priority	Stock exclusion + Weed management									
YAR001	3590	3	2	2	12	2400	\$ 5	\$ 17,950	3	2	2	Y	12	2000	\$ 1	\$ 21,540	3	3	2	Y	18	1059	\$ 12	\$ 61,031	0	0	0	Y	0	0	0	Y	0	0	\$ -	\$ -	2400	\$ 17,950	High priority	Weed management									
YAR094	3476	1	3	3	9	1800	\$ 5	\$ 17,380	0	0	0	Y	0	0	\$ 1	\$ -	0	0	0	Y	0	0	\$ 12	\$ -	0	0	0	Y	0	0	0	Y	0	0	\$ -	\$ -	1800	\$ 17,380	High priority	Weed management									
YAR017	2199	3	3	1	9	1800	\$ 5	\$ 10,995	0	0	0	Y	0	0	\$ 1	\$ -	0	0	0	Y	0	0	\$ 12	\$ -	0	0	0	Y	0	0	0	Y	0	0	\$ -	\$ -	1800	\$ 10,995	High priority	Weed management									
YAR010	423	3	2	1	6	1200	\$ 5	\$ 2,117	3	2	1	Y	6	1000	\$ 1	\$ 2,541	3	3	2	Y	18	1059	\$ 12	\$ 7,199	0	0	0	Y	0	0	0	Y	0	0	\$ -	\$ -	1200	\$ 2,117	Moderate priority	Weed management									
YAR084	2054	2	1	3	6	1200	\$ 5	\$ 10,272	0	0	0	Y	0	0	\$ 1	\$ -	0	0	0	Y	0	0	\$ 12	\$ -	0	0	0	Y	0	0	0	Y	0	0	\$ -	\$ -	1200	\$ 10,272	Moderate priority	Weed management									
YAR090	2088	1	3	2	6	1200	\$ 5	\$ 10,438	0	0	0	Y	0	0	\$ 1	\$ -	0	0	0	Y	0	0	\$ 12	\$ -	0	0	0	Y	0	0	0	Y	0	0	\$ -	\$ -	1200	\$ 10,438	Moderate priority	Weed management									
YAR008	2025	3	2	1	6	1200	\$ 5	\$ 10,126	0	0	0	Y	0	0	\$ 1	\$ -	0	0	0	Y	0	0	\$ 12	\$ -	0	0	0	Y	0	0	0	Y	0	0	\$ -	\$ -	1200	\$ 10,126	Moderate priority	Weed management									
YAR009	586	3	2	1	6	1200	\$ 5	\$ 2,931	0	0	0	Y	0	0	\$ 1	\$ -	0	0	0	Y	0	0	\$ 12	\$ -	0	0	0	Y	0	0	0	Y	0	0	\$ -	\$ -	1200	\$ 2,931	Moderate priority	Weed management									
YAR014	1072	3	2	1	6	1200	\$ 5	\$ 5,362	0	0	0	Y	0	0	\$ 1	\$ -	0	0	0	Y	0	0	\$ 12	\$ -	0	0	0	Y	0	0	0	Y	0	0	\$ -	\$ -	1200	\$ 5,362	Moderate priority	Weed management									
YAR063	1885	1	3	2	6	1200	\$ 5	\$ 9,425	0	0	0	Y	0	0	\$ 1	\$ -	0	0	0	Y	0	0	\$ 12	\$ -	0	0	0	Y	0	0	0	Y	0	0	\$ -	\$ -	1200	\$ 9,425	Moderate priority	Weed management									
YAR064	1160	1	3	2	6	1200	\$ 5	\$ 5,802	0	0	0	Y	0	0	\$ 1	\$ -	0	0	0	Y	0	0	\$ 12	\$ -	0	0	0	Y	0	0	0	Y	0	0	\$ -	\$ -	1200	\$ 5,802	Moderate priority	Weed management									
YAR078	185	1	3	2	6	1200	\$ 5	\$ 924	0	0	0	Y	0	0	\$ 1	\$ -	0	0	0	Y	0	0	\$ 12	\$ -	0	0	0	Y	0	0	0	Y	0	0	\$ -	\$ -	1200	\$ 924	Moderate priority	Weed management *									
YAR029	838	2	2	1	4	800	\$ 5	\$ 4,191	2	2	1	Y	4	667	\$ 1	\$ 5,029	3	3	2	Y	18	1059	\$ 12	\$ 14,250	0	0	0	Y	0	0	0	Y	0	0	\$ -	\$ -	1059	\$ 14,250	Moderate priority	Stock exclusion + Fence + Weed management									
YAR030	815	2	2	1	4	800	\$ 5	\$ 4,075	2	2	1	Y	4	667	\$ 1	\$ 4,890	3	3	2	Y	18	1059	\$ 12	\$ 13,855	0	0	0	Y	0	0	0	Y	0																

YAR075	62	1	1	1	1	200	\$	5	\$	308	0	0	0	Y	0	0	\$	1	\$	-	0	0	0	Y	0	0	\$	12	\$	-	0	0	0	Y	0	0	\$	-	\$	-	200	\$	308	Low priority	Weed management
YAR081	3280	1	1	1	1	200	\$	5	\$	16,402	0	0	0	Y	0	0	\$	1	\$	-	0	0	0	Y	0	0	\$	12	\$	-	0	0	0	Y	0	0	\$	-	\$	-	200	\$	16,402	Low priority	Weed management
YAR091	3845	1	1	1	1	200	\$	5	\$	19,227	0	0	0	Y	0	0	\$	1	\$	-	0	0	0	Y	0	0	\$	12	\$	-	0	0	0	Y	0	0	\$	-	\$	-	200	\$	19,227	Low priority	Weed management
YAR071	29	0	0	0	0	0	\$	5	\$	-	0	0	0	N	0	0	\$	1	\$	-	0	0	0	N	0	0	\$	12	\$	-	2	1	1	N	2	11	\$	5,000	\$	5,000	11	\$	5,000	Low priority	Earthworks or structure *
COR001	1011	0	0	0	0	0	\$	5	\$	-	0	0	0	N	0	0	\$	1	\$	-	0	0	0	N	0	0	\$	12	\$	-	0	0	0	N	0	0	\$	-	\$	-	0	\$	-	N/A	N/A
COR002	1742	0	0	0	0	0	\$	5	\$	-	0	0	0	N	0	0	\$	1	\$	-	0	0	0	N	0	0	\$	12	\$	-	0	0	0	N	0	0	\$	-	\$	-	0	\$	-	N/A	N/A
COR003	696	0	0	0	0	0	\$	5	\$	-	0	0	0	N	0	0	\$	1	\$	-	0	0	0	N	0	0	\$	12	\$	-	0	0	0	N	0	0	\$	-	\$	-	0	\$	-	N/A	N/A
DAR001	159	0	0	0	0	0	\$	5	\$	-	0	0	0	N	0	0	\$	1	\$	-	0	0	0	N	0	0	\$	12	\$	-	0	0	0	N	0	0	\$	-	\$	-	0	\$	-	N/A	N/A
YAR002	1314	0	0	0	0	0	\$	5	\$	-	0	0	0	N	0	0	\$	1	\$	-	0	0	0	N	0	0	\$	12	\$	-	0	0	0	N	0	0	\$	-	\$	-	0	\$	-	N/A	N/A
YAR006	913	0	0	0	0	0	\$	5	\$	-	0	0	0	N	0	0	\$	1	\$	-	0	0	0	N	0	0	\$	12	\$	-	0	0	0	N	0	0	\$	-	\$	-	0	\$	-	N/A	N/A
YAR007	991	0	0	0	0	0	\$	5	\$	-	0	0	0	N	0	0	\$	1	\$	-	0	0	0	N	0	0	\$	12	\$	-	0	0	0	N	0	0	\$	-	\$	-	0	\$	-	N/A	N/A
YAR015	780	0	0	0	0	0	\$	5	\$	-	0	0	0	N	0	0	\$	1	\$	-	0	0	0	N	0	0	\$	12	\$	-	0	0	0	N	0	0	\$	-	\$	-	0	\$	-	N/A	N/A
YAR025	2233	0	0	0	0	0	\$	5	\$	-	0	0	0	N	0	0	\$	1	\$	-	0	0	0	N	0	0	\$	12	\$	-	0	0	0	N	0	0	\$	-	\$	-	0	\$	-	N/A	N/A
YAR042	4840	0	0	0	0	0	\$	5	\$	-	0	0	0	N	0	0	\$	1	\$	-	0	0	0	N	0	0	\$	12	\$	-	0	0	0	N	0	0	\$	-	\$	-	0	\$	-	N/A	N/A
YAR046	50	0	0	0	0	0	\$	5	\$	-	0	0	0	N	0	0	\$	1	\$	-	0	0	0	N	0	0	\$	12	\$	-	0	0	0	N	0	0	\$	-	\$	-	0	\$	-	N/A	N/A
YAR047	1179	0	0	0	0	0	\$	5	\$	-	0	0	0	N	0	0	\$	1	\$	-	0	0	0	N	0	0	\$	12	\$	-	0	0	0	N	0	0	\$	-	\$	-	0	\$	-	N/A	N/A
YAR048	1487	1	0	0	0	0	\$	5	\$	-	0	0	0	N	0	0	\$	1	\$	-	0	0	0	N	0	0	\$	12	\$	-	0	0	0	N	0	0	\$	-	\$	-	0	\$	-	N/A	N/A
YAR050	514	0	0	0	0	0	\$	5	\$	-	0	0	0	N	0	0	\$	1	\$	-	0	0	0	N	0	0	\$	12	\$	-	0	0	0	N	0	0	\$	-	\$	-	0	\$	-	N/A	N/A
YAR051	2085	0	0	0	0	0	\$	5	\$	-	0	0	0	N	0	0	\$	1	\$	-	0	0	0	N	0	0	\$	12	\$	-	0	0	0	N	0	0	\$	-	\$	-	0	\$	-	N/A	N/A
YAR052	1266	0	0	0	0	0	\$	5	\$	-	0	0	0	N	0	0	\$	1	\$	-	0	0	0	N	0	0	\$	12	\$	-	0	0	0	N	0	0	\$	-	\$	-	0	\$	-	N/A	N/A
YAR053	1155	0	0	0	0	0	\$	5	\$	-	0	0	0	N	0	0	\$	1	\$	-	0	0	0	N	0	0	\$	12	\$	-	0	0	0	N	0	0	\$	-	\$	-	0	\$	-	N/A	N/A
YAR054	2799	0	0	0	0	0	\$	5	\$	-	0	0	0	N	0	0	\$	1	\$	-	0	0	0	N	0	0	\$	12	\$	-	0	0	0	N	0	0	\$	-	\$	-	0	\$	-	N/A	N/A
YAR062	3331	0	0	0	0	0	\$	5	\$	-	0	0	0	N	0	0	\$	1	\$	-	0	0	0	N	0	0	\$	12	\$	-	0	0	0	N	0	0	\$	-	\$	-	0	\$	-	N/A	N/A
YAR068	553	0	0	0	0	0	\$	5	\$	-	0	0	0	N	0	0	\$	1	\$	-	0	0	0	N	0	0	\$	12	\$	-	0	0	0	N	0	0	\$	-	\$	-	0	\$	-	N/A	N/A
YAR070	1596	0	0	0	0	0	\$	5	\$	-	0	0	0	N	0	0	\$	1	\$	-	0	0	0	N	0	0	\$	12	\$	-	0	0	0	N	0	0	\$	-	\$	-	0	\$	-	N/A	N/A
YAR076	1405	0	0	0	0	0	\$	5	\$	-	0	0	0	N	0	0	\$	1	\$	-	0	0	2	N	0	0	\$	12	\$	-	0	0	0	N	0	0	\$	-	\$	-	0	\$	-	N/A	N/A
YAR079	797	0	0	0	0	0	\$	5	\$	-	0	0	0	N	0	0	\$	1	\$	-	0	0	0	N	0	0	\$	12	\$	-	0	0	0	N	0	0	\$	-	\$	-	0	\$	-	N/A	N/A
YAR080	1339	0	0	0	0	0	\$	5	\$	-	0	0	0	N	0	0	\$	1	\$	-	0	0	0	N	0	0	\$	12	\$	-	0	0	0	N	0	0	\$	-	\$	-	0	\$	-	N/A	N/A
YAR082	1516	0	0	0	0	0	\$	5	\$	-	0	0	0	N	0	0	\$	1	\$	-	0	0	0	N	0	0	\$	12	\$	-	0	0	0	N	0	0	\$	-	\$	-	0	\$	-	N/A	N/A
YAR083	943	0	0	0	0	0	\$	5	\$	-	0	0	0	N	0	0	\$	1	\$	-	0	0	0	N	0	0	\$	12	\$	-	0	0	0	N	0	0	\$	-	\$	-	0	\$	-	N/A	N/A
YAR093	3346	0	0	0	0	0	\$	5	\$	-	0	0	0	N	0	0	\$	1	\$	-	0	0	0	N	0	0	\$	12	\$	-	0	0	0	N	0	0	\$	-	\$	-	0	\$	-	N/A	N/A
YAR095	1270	0	0	0	0	0	\$	5	\$	-	0	0	0	N	0	0	\$	1	\$	-	0	0	0	N	0	0	\$	12	\$	-	0	0	0	N	0	0	\$	-	\$	-	0	\$	-	N/A	N/A
YAR096	466	0	0	0	0	0	\$	5	\$	-	0	0	0	N	0	0	\$	1	\$	-	0	0	0	N	0	0	\$	12	\$	-	0	0	0	N	0	0	\$	-	\$	-	0	\$	-	N/A	N/A
YAR097	1149	0	0	0	0	0	\$	5	\$	-	0	0	0	N	0	0	\$	1	\$	-	0	0	0	N	0	0	\$	12	\$	-	0	0	0	N	0	0	\$	-	\$	-	0	\$	-	N/A	N/A

¹ Priority rating is based on waterway benefits. If integrity or safety of existing structure is severely compromised, structural works would become a higher priority



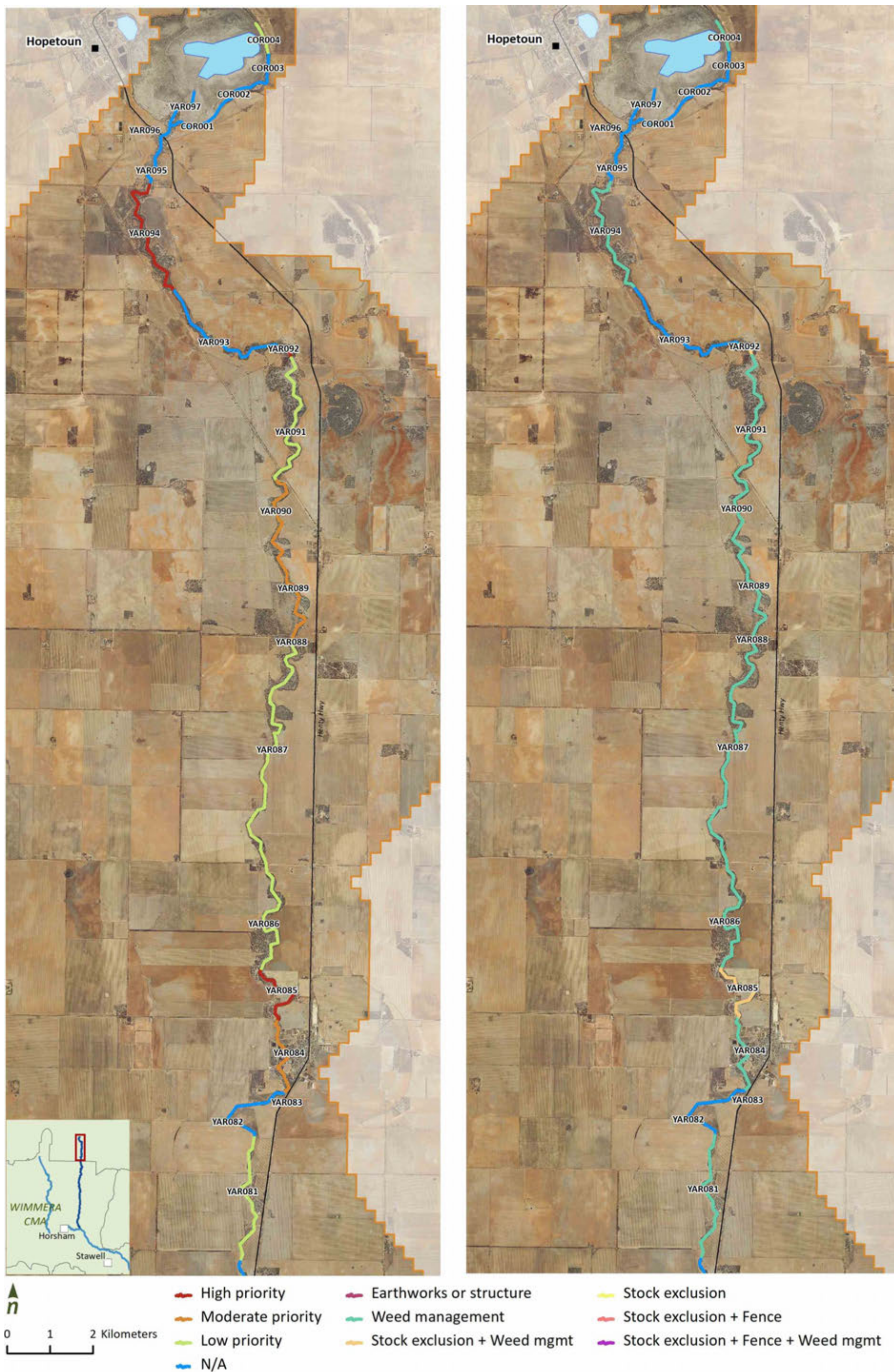


Figure 39. Priority ranking (left) and action (right) for the northern lower catchment

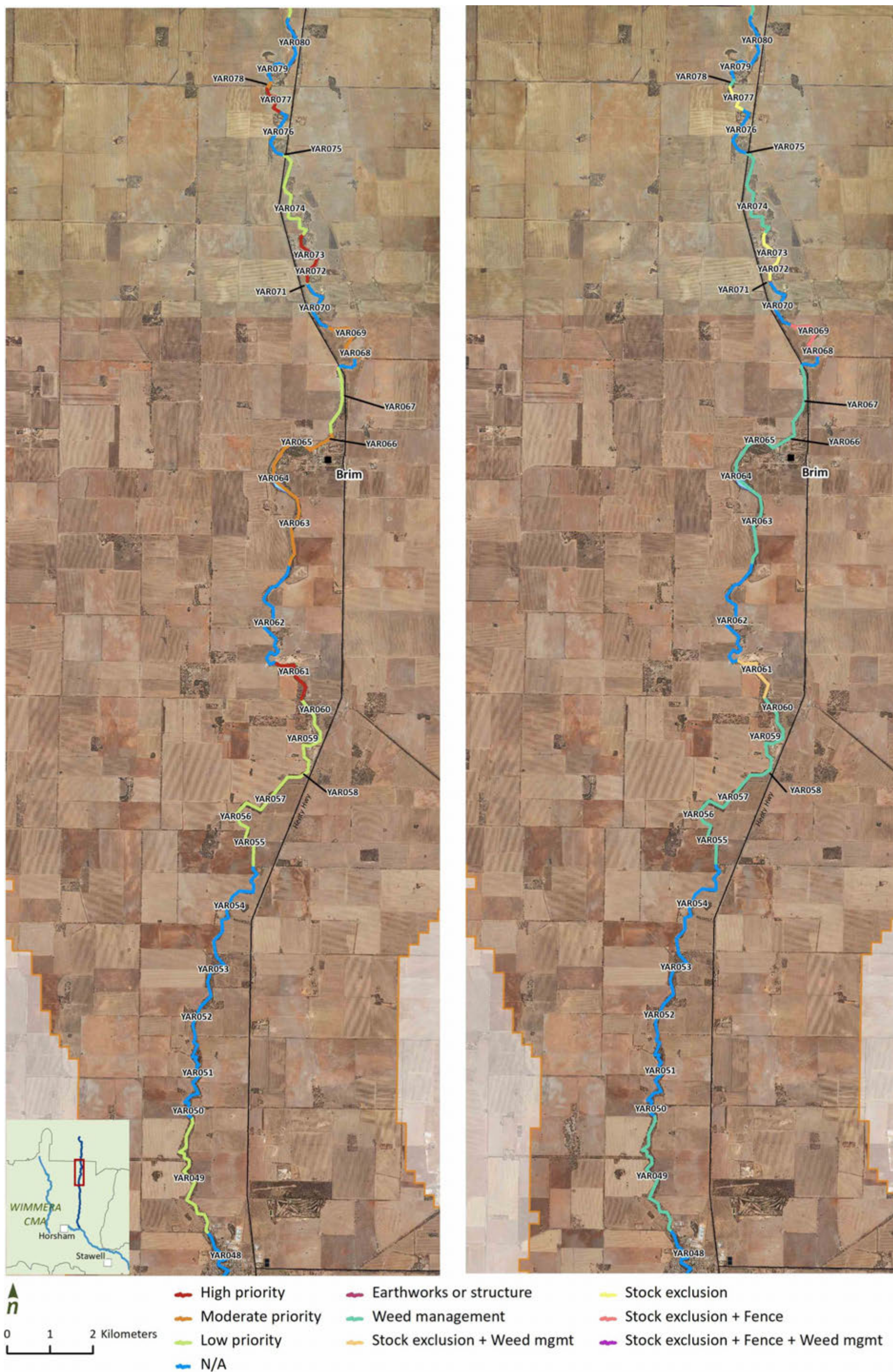


Figure 40. Priority ranking (left) and action (right) for the southern lower catchment

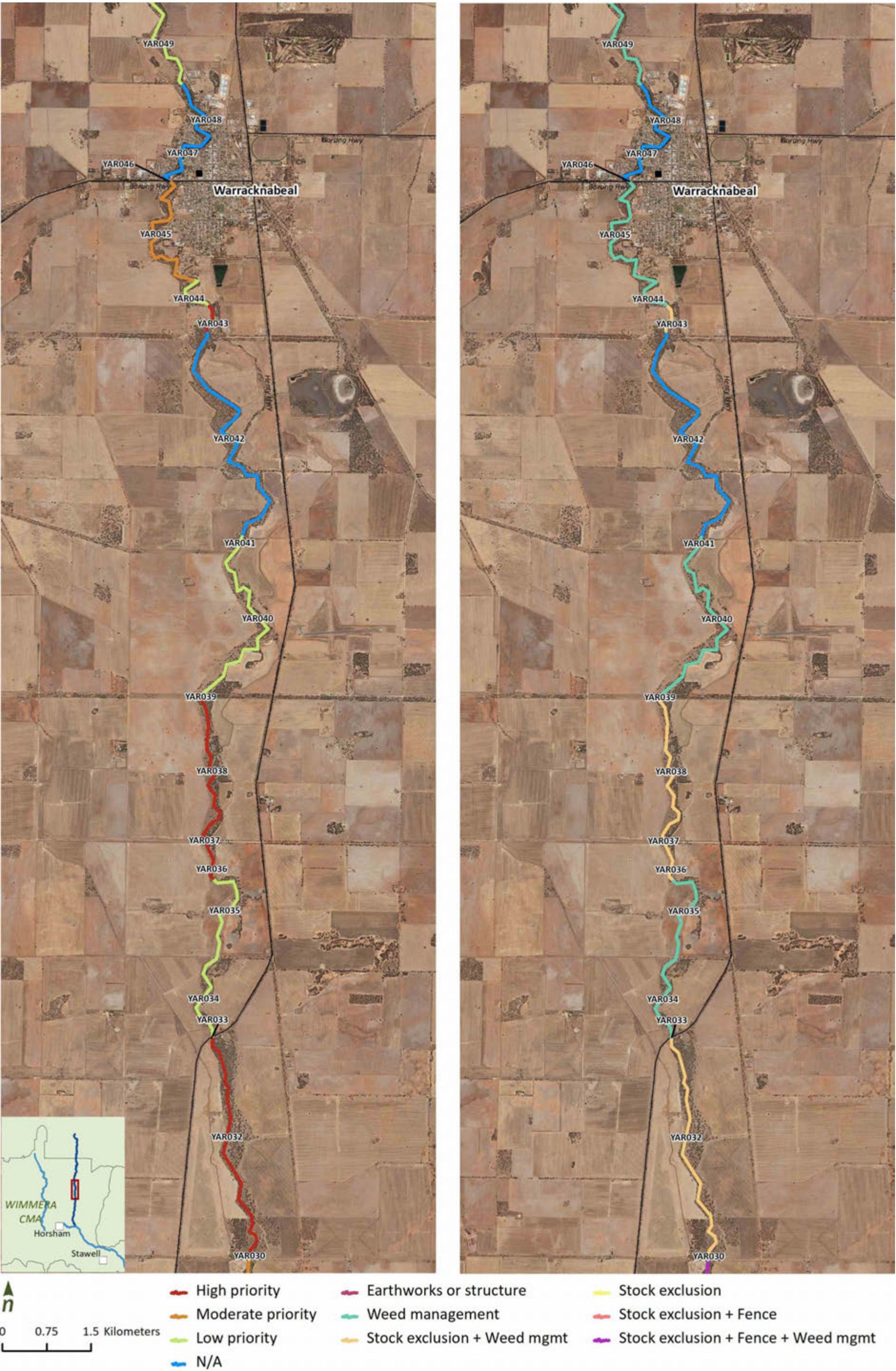


Figure 41. Priority ranking (left) and action (right) for the northern mid catchment

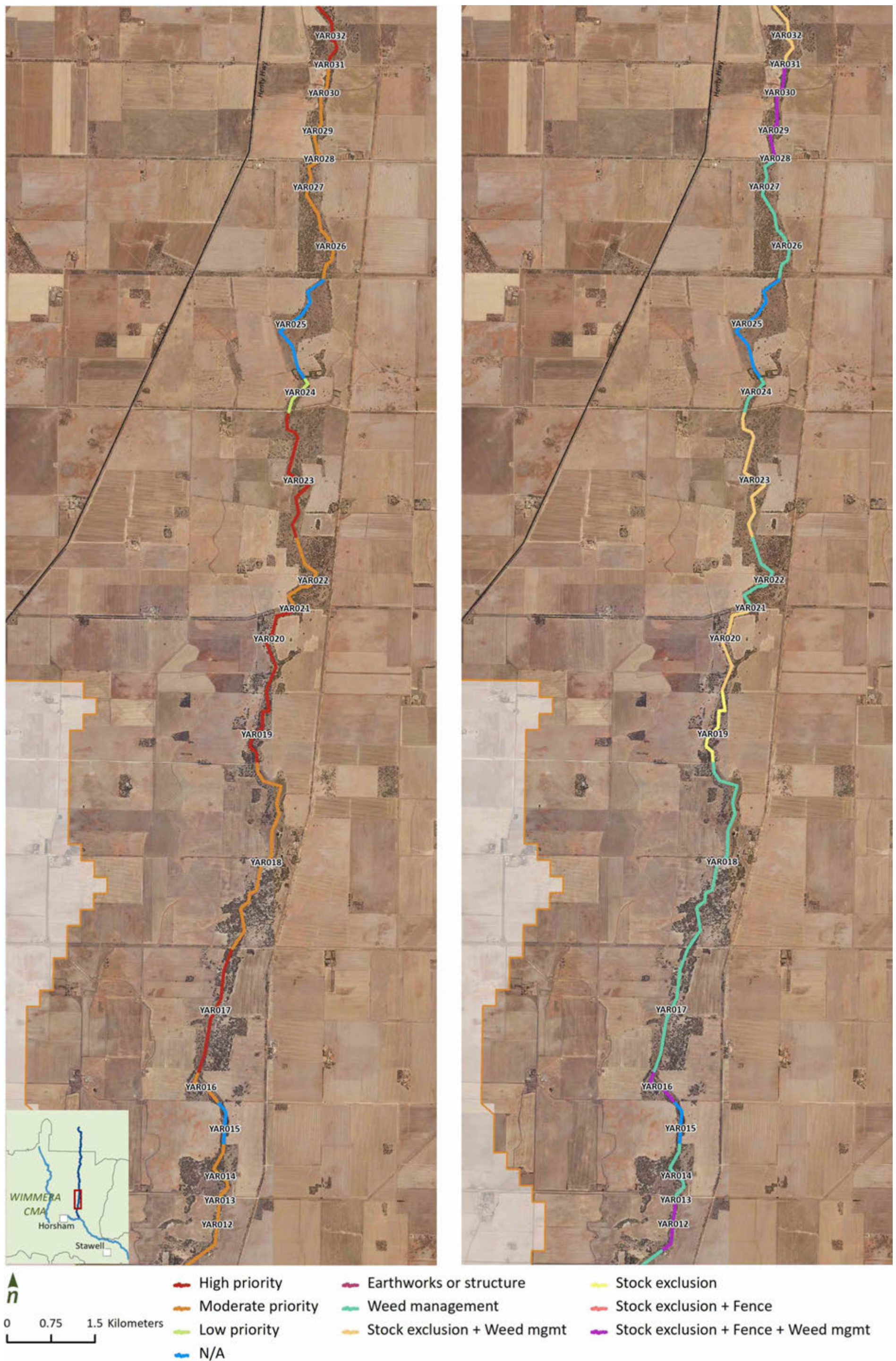


Figure 42. Priority ranking (left) and action (right) for the southern mid catchment



Figure 43. Priority ranking (left) and action (right) for the upper catchme